WATER WORKS & SEWERAGE

L. H. ENSLOW, Editor

Vol. LXXIX, No. 4

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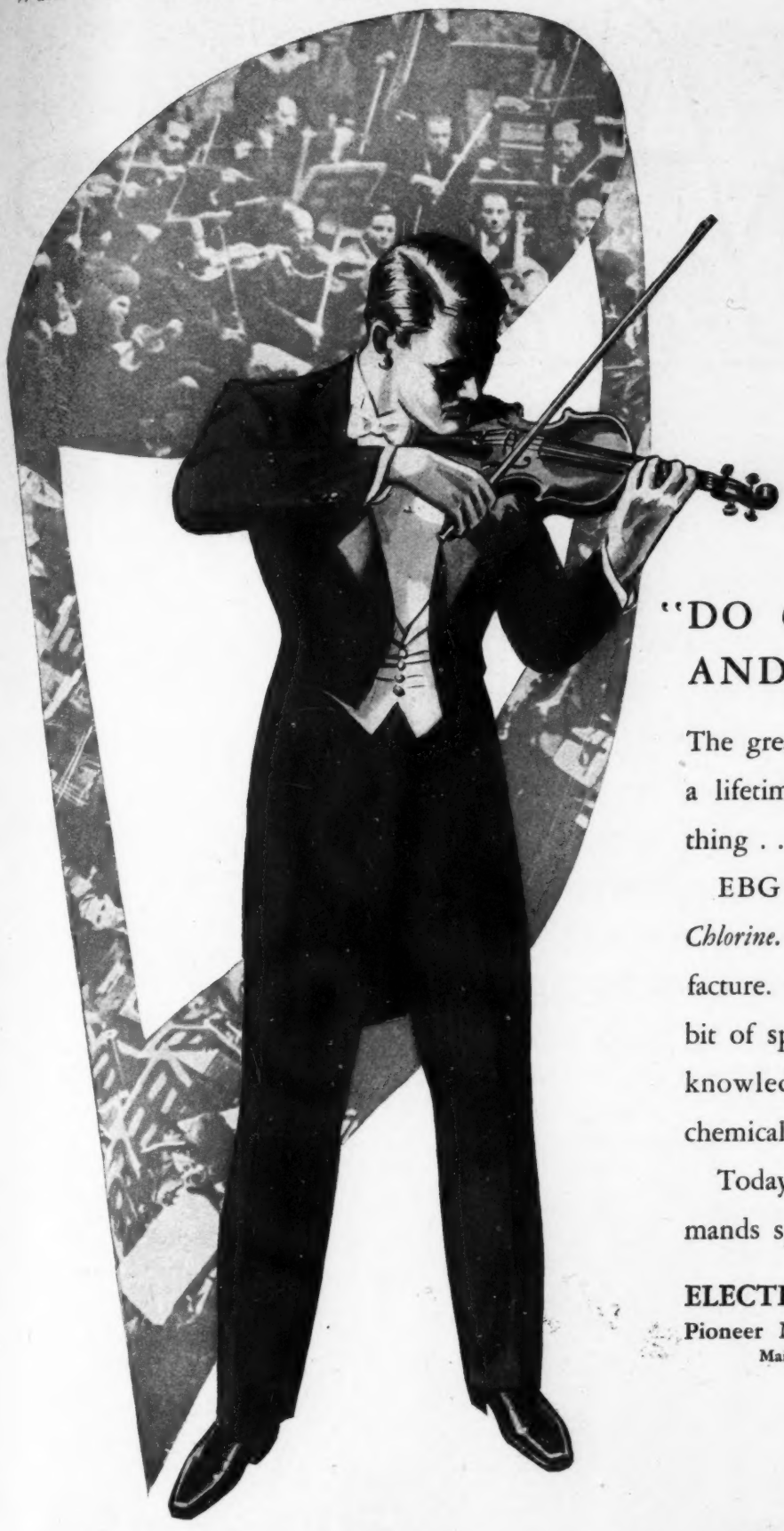

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WATER WORKS AND SEWERAGE

VOL. 79 — No. 4 — APR. 1932

A GILLETTE PUBLICATION

IMPROVED MECHANICAL TREATMENT OF WATER FOR FILTRATION

By MARSDEN C. SMITH, M. E.

Engineer of Water and Electricity,
Department of Utilities, Richmond, Va.

Marsden C. Smith

THE water works engineer, always striving to furnish a better water to his community, will find that the future advancement in the art of water purification will be improvements in the preparation of water for filtration. Perhaps more importance will be attached to this feature than in any phase of plant operation. It is hoped that this article, which details the results of several years of intensive study of this subject at the Richmond, Va., filter plant, will prove of general interest.

The rate at which water to be filtered is passed through the sand or filter medium varies greatly with the type of plant. This rate may be as low as 60 gallons per square foot of area per day in the "Slow Sand" filter plant, or as high as 4000 gallons or more, in the same unit, in the "Rapid Sand" plant. From this it is readily seen that the adsorbing action in the "Slow Sand" filter is vastly greater than that using the higher rates. In addition, other important actions aiding the "Slow Sand" filter, which are negligible or absent in the "Rapid Sand" filter, greatly increase this difference. In other words, water to be filtered by a "Rapid Sand" filter must be adequately prepared, prior to filtration, to compensate for these differences in the functions of the rapid sand filter bed. When a plant is designed as a "Rapid Sand" type, and the preparation of the water for filtration is deficient, either the filters must be made to approach the "Slow" rates, with a consequent reduction in plant capacity, or the filter effluent must become unsatisfactory. Generally there is not sufficient filter area to avoid both of these undesirable effects.

When the water for filtration is improperly prepared, failure to secure precipitation in the basins provided for that purpose results, and the time interval between necessary filter washing is shortened. This increases the use of wash water, which, though not always recognized, constitutes an important item of operating expense.

Further, the writer is convinced by experience, that the apparent benefits derived from the use of larger sizes of sand in the filter, cannot become available unless the water to be filtered is at all times successfully prepared. And, finally, the cost of coagulation constitutes the largest item of expense in the operation of most plants. Any appreciable reduction in the quantity of coagulant required, is an additional benefit which can be secured by successfully improving coagulation which is the most important phase of plant operation.

Having experienced all of the difficulties that result from inadequate preparation of water for filtration, even to the extent of frequent almost total collapses of the purification process, intensive studies were made to determine how best to remove the overload being placed upon the filters. These studies led to certain definite and interesting facts concerning the formation and subsequent behavior of the floc. They confirmed the long

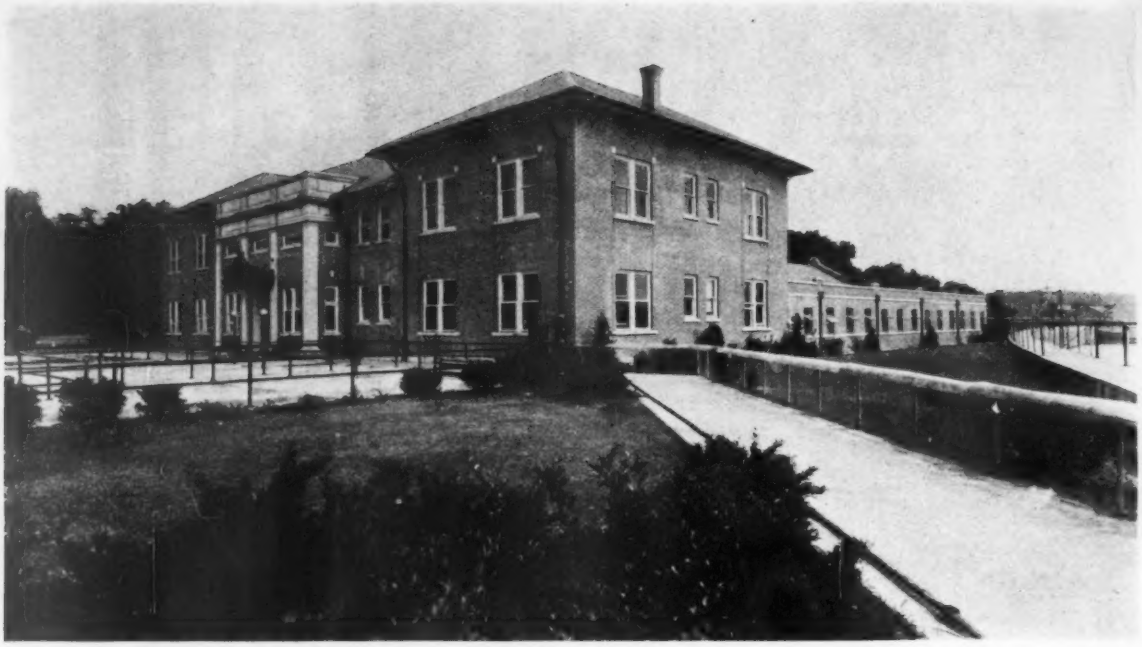


Fig. 1—Filtration Plant, Richmond, Va., Mixing Chambers in Left Foreground. "Flocculators" (Not Shown) Are Down in the Coagulation Basin to the Left. See Fig. 2

recognized fact that thorough and immediate mixing of the coagulant is essential if efficient results are to be obtained.

It need hardly be recorded that there is a minimum amount of coagulant required for floc formation in a given water, and no amount of mechanical treatment can compensate for the failure to use this minimum of coagulant. But it was shown to be equally true that this minimum may be attained only when the subsequent treatment during and after floc formation is as perfect as it may be practical to make it.

Further, it was conclusively demonstrated that there are at least three main considerations that control the perfection of this subsequent treatment. These are, (1) the time that the floc is kept in suspension, (2) the mechanical treatment of the floc while held in suspension and, (3) the proper return to the incoming treated water of a portion of the settled floc and turbidity.

Briefly considering these in order, it was found that the time required before permitting the settlement of the floc is a function of the water quality and its temperature.

Time is indeed a factor, but the motion given the floc is perhaps of even greater importance. A circulatory, twisting, sweeping confusion of the floc, resembling snow swirls, *under the control* of the operator is the desideratum. Inadequate motion and insufficient time frequently result in a floc of deficient quality. This deficiency may be of either of two opposite natures. First, the formation of a floc although tenacious, is one low in absorbtive capacity; the other, obtained frequently in cold water, is a large and feathery but fragil floc. This latter type is even more undesirable than the former, because it is practically impossible to settle, and upon the slightest agitation color and other floc constituents return to the colloidal state or enter into solution, passing through the filters as though no coagulation had been obtained. Proper time and motion during flocculation apparently eliminate the former difficulty. At times they may not prevent the light floc being formed, but it is made so tenacious that it causes nothing more serious than a moderate decrease in the length of filter runs. Thus sufficient time and proper motion were found to produce a marked improvement in the quality and efficiency of the floc.

Proceeding a step further, an appreciable increase in efficiency with a nearer approach to the absolute minimum amount of coagulant required was obtained when a portion of the settled floc and turbidity was properly returned and mixed with the incoming treated water.

It then remained a problem as to how best to profit from the information gained from these studies. Additional baffle type of chambers were known to be expensive to construct, to require much additional head, to be unable to produce the desired floc motion, to be difficult to design so as to control the intensity of the floc motion with varying quantities of treated water, and to prevent the proper return of the settled floc. It was decided to proceed with the development of mechanical mixing devices.

The principles of the machines here described were worked out by the writer to incorporate all of the conditions the coagulation studies had proven desirable, and, at the same time, avoid the disadvantages of the baffled chambers. They were furnished by the Dorr Company, who detailed their design.

The essential features of the design are: horizontal shafts, the length of which are at right angles to the flow of the water. To these shafts must be attached paddles to produce the motion and prevent settlement (until desired) of the floc. All shafts must rotate in the same direction, and this direction is such that the part of the paddles above the shafts move in the direction of flow, and that below the shafts against the direction of the flow of the water through the basins. Due to the small horizontal velocity of the water in the usual coagulated water settling basins, the revolution of the paddles creates an outward travel to the upper stratum of coagulated water and an inward motion to the lower stratum. Thus the settled floc is gently swept back along the bottom of the basins and is elevated by the upward motion of the paddles nearest the intake end and is mixed with the incoming treated water. If the floc is found to travel too far from the most remote paddle before settling, it becomes necessary to construct a weir across the basin, to accumulate the settled floc, so that

the paddles may draw back a sufficient quantity to obtain the benefits of this feature.

The area between the adjacent shafts is in a constant swirl due to the paddles there traveling in opposite directions, and a splendid motion of the floc results.

Then there must be provided suitable motive power. This should preferably be obtained from a variable speed motor, connected through a suitable reduction gear to the first shaft. Each succeeding shaft is connected in turn, so that all rotate at the same speed.

As many parallel shafts may be used as required to give the retention found by experiment to be advisable. It is also important to admit the treated water from the mixing chambers into the coagulating basins above the shafts, and uniformly across the width of the basins.

At the Richmond plant four of these machines have been installed, one at the inlet end of each of the four coagulating basins. Each of these machines have four parallel shafts placed 20 ft. between centers, with 10 ft. from the inlet to the first shaft. This gives a theoretical retention of 70 minutes when the plant is operated at its rated capacity of thirty million gallons per day. This is in addition to the 10 minutes retention in the mixing chambers.

Each set of four shafts is driven by a separate 3 H.P. variable speed motor, permitting the shafts to be rotated at any speed from one to three revolutions per minute. At the maximum speed the power consumption is about 2.4 kilowatt-hours per hour.

It is difficult to determine an exact measure of the improvement obtained by changes in the structure and operation of the Richmond plant. This is because of the many variables in the quality of the river water, and, in addition, to the relatively large quantities of water in the various basins and thus introducing time lags that overlap river changes.

The plant laboratory equipment includes an unusually successful multiple stirring machine, by means of which the amount of coagulant required for plant operation has been checked. This machine will hereafter be referred to as the "Laboratory." Practice had shown that, for several reasons, previous to the installation of the new machines the amount of alum required for plant operation, had exceeded that indicated in the laboratory by from three to six-tenths of one grain.

For two weeks prior to starting the new machines described above, the laboratory indicated an average of 3.22 grains of alum needed. During this time, the plant actually required an average of 3.82 grains. That is, the plant required an average of six-tenths of a grain more than the laboratory indicated. During a three weeks intensive test after starting the new machines, the laboratory indicated an average of 2.37 grains; whereas the plant required an average of only 1.88 grains. That is, the plant required an average of forty-five hundredths of a grain *less* than the laboratory indicated. This indicates that the plant was operated, with a filter effluent as satisfactory, if not more so, with 1.05 grains less than would have been required had not the new machines been in service.

Other even more evident improvements were noted. An attempt was made to operate the number one and two basins [at that time having no machines] and taking water from the same mixing chambers as basins number three and four, having machines. As a result of this test the water from basins one and two was so poorly prepared that even though diluted one-half by the splendid water from basins three and four, the filter runs were almost halved, and the effluent from the filters was so unsatisfactory that the operation could be continued for only 40 hours. Upon cutting off basins one and two, with the amount of coagulant unchanged, the filter effluent and runs become entirely satisfactory.

An analysis of the unfiltered effluent from the four basins during the above test gave the following results:

Basin No.	1	2	3	4
	(No machines)		(With machines)	
Residual Al_2O_3	0.8	0.8 p.p.m.	0.25	0.25 p.p.m.
Residual Color	7	7 p.p.m.	3	3 p.p.m.

Furthermore, the visible difference in the effluents from the basins during this same test was very marked;

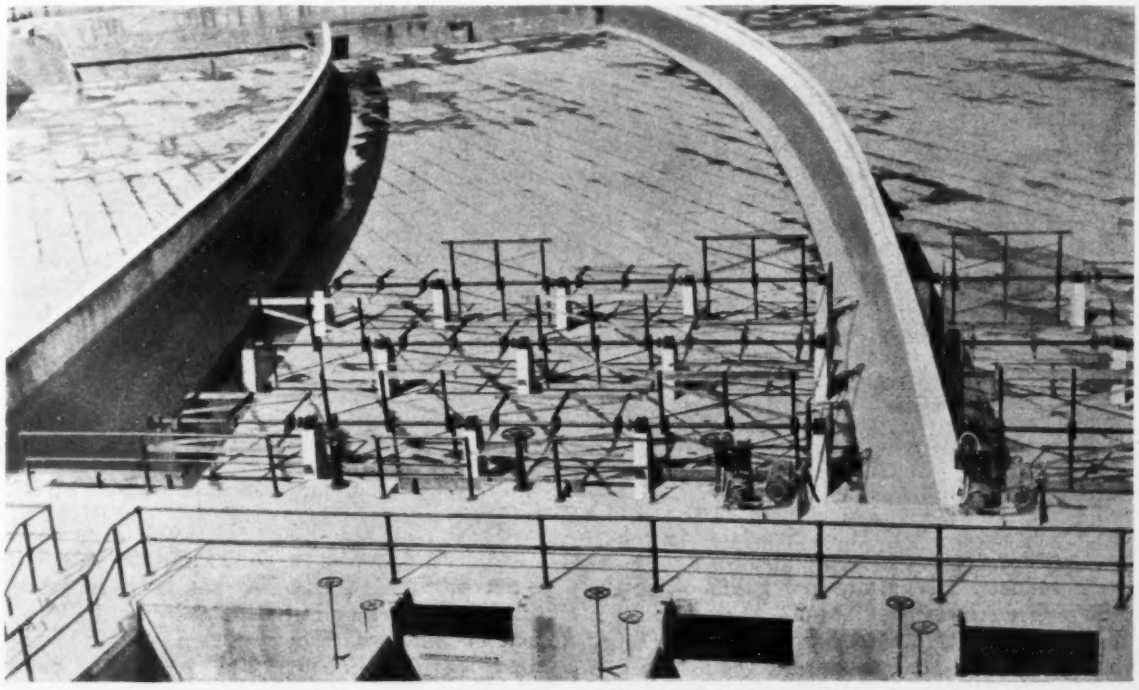


Fig. 2—"Flocculators" Installed at the Inlet End of Coagulation Basins, Richmond Filtration Plant. Note the 3 H.P. Motor, Reducing-Gear and Drive Chains to Right Center. Note also the Decreasing Width of Paddle Blades to Gradually Reduce Velocity of Agitation As the Water Passes Through the Floc- culating Zone. The Wall on the Left Is One of the Around-End Baffles

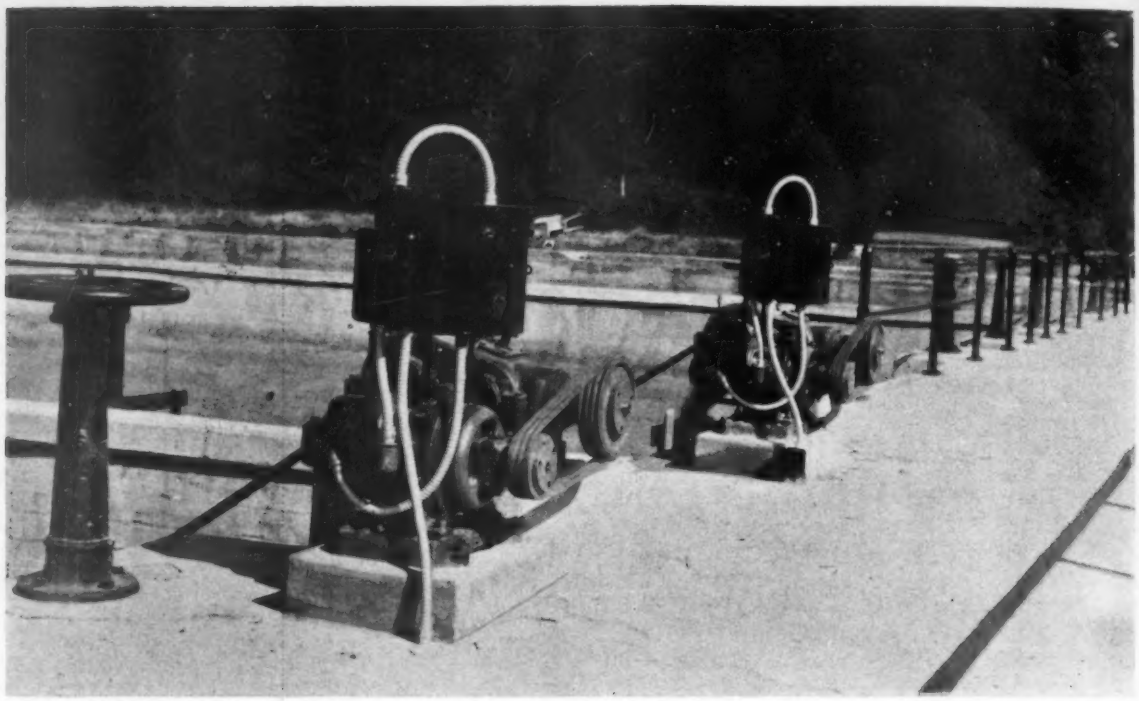


Fig. 3—Close-Up of Drive Motors (3 H.P.) and Speed Reducing Gear. Variable Speed Motors Allow Speed Variation of Paddles 1 to 3 Revolutions Per Minute

that from basins one and two was very cloudy and milky in appearance, while that from basins three and four was so clear that small objects on the bottom could be plainly seen 8½ ft. under water.

A most startling difference was noted in the settlement of the floc. In basins one and two, without machines, the settlement was at so slow a rate that it spread throughout the length of the basins 700 ft. long but in the basins equipped with machines, almost all of the floc settled within 50 ft. of the last paddle. During the period of lowest winter temperatures a slower settlement has occasionally been observed, but the fragil floc, always before so serious at these temperatures, has not appeared at any time. This is a remarkable demonstration of the improved quality of the floc that is obtained by the new machines.

At the time this is written the new machines have just been installed in basins one and two, and the effect of the full retention has not at any time been available. However the following average results of the four months the machines have operated with one-half of the coagulating basins in service, are certainly interesting. It should be noted that basins one and two have not been in service during the period covered except for the few days necessary to clean the machine equipped basins.

AVERAGE RESULTS FOR FOUR MONTHS

	——Raw Water——				——Finished Water——		
	Turbidity ppm	Color ppm	(Oxy. Cons.)* ppm	Alum Used Gr.p.G	Color ppm	(Oxy. Cons.) ppm	Alum ppm
Last Year	21.7	46.1	16.8	4.47	4.22	4.7	0.139
This Year	61.7	51.3	7.1	2.30	2.79	2.9	0.048

*Permanganate digestion—A. P. H. A. Standard Method.

It is seen that the average alum required for coagulation has been reduced 2.17 grains per gallon since the machines have been installed. At an average of six hundred million gallons treated per month, and crediting the machines with only one-half of this reduction, this results in an average saving of approximately $1400 per month. At the same time a vast improvement has been made in the length of filter runs and the quality of the filtered water.

Acknowledgment is made of the valuable assistance of F. O. Baldwin, and C. F. Bingham in the preparation of this article.

▼

Control of Federal Water Service Corporation Goes to Employees

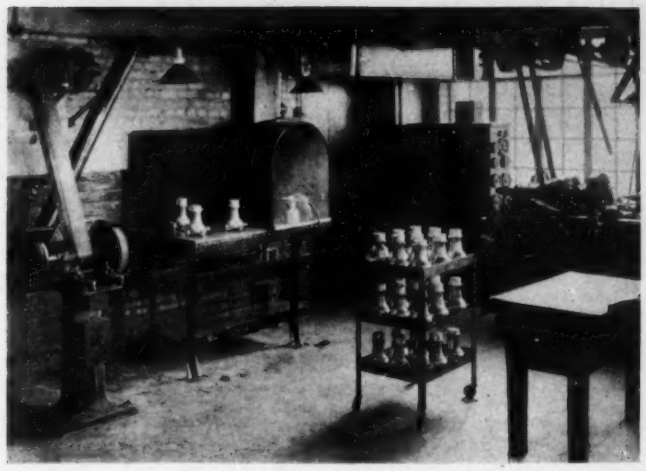
More than 1100 of the 1700 employees and officials of the Federal Water Service Corporation have recently become part owners of the corporation. The plan was sponsored by C. T. Chenery, president of the company. Thus the Federal Company, under this plan, becomes the only large public utility enterprise controlled by its officers and employees. At latest reports the assets of the corporation amounted to about $200,000,000.

Employees of all of the 123 plants serving 308 communities in eleven States have received permission to become stockholders in the Utility Operators Company which is the new corporation formed to take over control (63 per cent) of Federal's Class B voting stock. Each of the 1100 officers and employees of the group subscribed to shares of Utility Operators Company on exactly the same basis. This development was brought about as the result of failure of the Tri Utilities Corporation, the former holding company which went into receivership. Under the new plan Federal Water Service Corporation becomes entirely independent of any other utility group.

▼

LOS ANGELES WATER DEPARTMENT SHOWS PROFIT.—A net profit of $2,106,370 has been reported for the Los Angeles Water Department by H. A. Van Norman, General Manager. The profit on water and power combined was $6,450,659. The profit on water supply operation decreased about 18 per cent below the profit of 1930 primarily on account of pumping costs to deliver a greater portion of ground water into the system in 1931.

Spray Painting Booth in Meter Shop



METER MAINTENANCE AT NEW ROCHELLE, N. Y.

By E. T. CRANCH

Manager,
New Rochelle Water Co.,
New Rochelle, N. Y.

ON November 15, 1926, the New Rochelle Water Company became a part of the Community Water Service Company. With this change of ownership many improvements were instituted and among these improvements were numerous changes in methods of operation and maintenance.

It was felt that the adequate inspection and maintenance of meters was one of the most important functions of the operating department. Many meters were found to have been in service a great number of years without having had any inspection or repairs. Attention was given first to the larger meters such as 3, 4, 6 and 8 in. These were usually tested and repaired in place though sometimes it was found necessary to remove them. In a number of cases these meters were also found to be considerably larger than the character of service demanded and many of them have been reduced to smaller sizes with excellent results. Large meters are now regularly tested three or four times a year. We are also endeavoring to provide all these installations with test plugs so that it is not necessary to call on the pitometer crew to make the test.

In 1928 the company moved into a new office building built according to its own specifications, in which excellent facilities were provided for the maintenance work on meters. Shortly after this, under the direction of U. S. Rutan, the New Rochelle Company took over the repair of meters for the Pocantico Water Works, the Port Chester Water Works and the Greenwich Water Company. The meter repair department is, therefore, now taking care of approximately 28,300 meters. It is our endeavor to have every meter go through the shop for a thorough overhauling at least every five years. This means that in routine operation an average of 5,660 meters must go through the shop every year.

Each of the above companies was originally using a different system of meter records or history cards. Some of these records were quite complicated and seemed to involve considerable unnecessary clerical work, so P. S. Wilson, then Superintendent of Operations for the Community Water Service Company, devised a simplified system of records which has now been adopted as a standard and is illustrated herewith.

Figure 1 shows the standard test card. This card is printed in two colors, blue and buff. The blue card is furnished to the meter manufacturer and is filled in by such manufacturer for each meter purchased. This gives our original record of the meter. The buff card is used for all special tests of meters, for instance on a customer's complaint before the meter is repaired. This card is made on light enough stock so that one carbon copy can be made. The original is filed with the meter records and the copy placed in the consumer's file.

Figure 2 shows the "Set Meter Order" card which is used for the setting of all meters. This card is made out by the Superintendent of the Meter Department, the stub being retained by him and the card given to the workman. The workman enters on the card the necessary data when the meter is set and returns it to the Meter Department where the data are entered on the meter reading book. The stub is then destroyed and the card filed among the meter records but in accordance with the consumer's account rather than by the number of the meter. The stub simply provides a check to see that all of the cards are returned.

Figure 3 shows the "Remove Meter Order" card which is used for all meters removed in the course of routine operation but is not used when a meter is removed for special test. This card follows at first the same sequence as the "Set Meter Order." It will be noted that the lines on the front to be filled in by the Superintendent of Meters coincide with the lines of the "Set Meter Order" so that ordinarily when a meter is to be removed and another set immediately in its place, the two cards are made out simultaneously by means of a carbon. When the "Remove Meter Order" is returned to the Meter Department and the data have been entered in the meter reading book, it is then sent to the testing room. The test of the meter after repair is entered on the back of the card* and it is then filed by meter number.

Figure 4 shows the "Remove Meter Order" which is used only in case of special test. This card is printed on a bright red, heavy stock card and is provided with a tag equipped with wire to be attached to the meter as soon as it is removed. In this case one of the test cards (Fig. 1) is made out before the meter is repaired. Otherwise the same procedure is followed as for the regular "Remove Meter Order."

These cards comprise the entire meter history record and we feel are quite complete and avoid considerable duplication in clerical work.

When a meter enters the repair shop the sequence of work is somewhat as follows:

The meters are first taken apart and lined up on the bench shown in Fig. 5. Then while the gear trains

**Ed. Note*—Only the front of these record cards is shown in the illustrations. Interested readers may procure a set of these cards from the author.

and registers are being repaired the main casings and disc chambers are dipped in the crocks as shown in Fig. 6. We have had considerable difficulty in finding a good cleaning solution. At first we tried acid but the fumes were too difficult to handle. We are now using Dearborn Special Treatment No. 134, manufactured by the Dearborn Chemical Company and while it does not clean the castings the way the acid would, it does a much better job than could be done by hand and there are no objectionable fumes. The chemical is diluted with three parts of water and used cold. The parts are then rinsed thoroughly in running hot water and brushed off. The bottom caps are not dipped but cleaned off by a motor driven wire wheel.

The meters are then reassembled. The bottom plates on all old style open gear trains are changed to the oil enclosed type and discs are accurately fitted into the disc chambers. All the necessary repair parts are stored in the steel bins shown back of the bench in Fig. 5. The drill press shown on the rear bench is equipped with a small wire brush which is found most useful for getting up into the disc chambers for final cleaning.

After the meters have been reassembled they are loaded on light steel trucks and wheeled over to the testing benches. The testing benches, five in number, are shown on Fig. 7. The bench nearest the window is used for testing 3 in., 4 in. and 6 in. meters. It is equipped with a 110 cu. ft. concrete tank built integral with the building. A branch pipe discharges into the 10 cu. ft. steel tank of a Ford testing outfit. This is used for measuring the small side of compound meters. A chain fall is mounted on a trolley over the bench for the purpose of conveniently moving the large meters. There are two Ford testing benches which can

METER NO. _____ _____

MAKE _____ SIZE _____ TYPE _____

REPORT OF TEST DATE _____ 19____

FLOW	LOW	INTERMEDIATE	HIGH	
	(COMMUNITY W. S. CO. STANDARD TEST FLOWS UNLESS NOTED)			
GALS./MIN.				
% REGIST.				

REASON FOR TEST _____

USE BACK OF CARD FOR OTHER DATA, REMARKS, ADDITIONAL TEST FLOWS ON LARGE METERS, ETC. BY _____ (METER TESTER)

FORM S.E. 503

SET METER ORDER

ACC'T NO. _____

DATE OF ORDER _____

WHEN TO SET _____

THIS STUB TO BE REMOVED BY METER SUPT. AND USED FOR CHECKING AGAINST COMPLETION OF WORK

ACCOUNT NO. _____ OLD METER BEING REMOVED AT SAME TIME . . . . { YES / NO

NAME _____ REASON _____ (FOR SETTING)

ADDRESS _____ CITY _____

WHEN TO SET _____ BY _____ (METER SUPT.)

SET METER ORDER DATE OF ORDER _____ 19____

DESCRIPTION OF METER ON BACK — PART ENTERED IN OFFICE AND COMPLETED ON JOB

DATE SET _____ 19____ TIME _____ M.

READING IN _____ BY _____

READING AND METER DESCRIPTION ENTERED IN READING BOOK

DATE _____ 19____ BY _____

FORM S.E. 502

REMOVE METER ORDER

ACC'T NO. _____

METER NO. _____

DATE OF ORDER _____

WHEN REMOVE _____

THIS STUB TO BE REMOVED BY METER SUPT. AND USED FOR CHECKING AGAINST COMPLETION OF WORK

ACCOUNT NO. _____ METER TO BE REPLACED AT SAME TIME . . . { YES / NO

NAME _____ REASON _____ (FOR REMOVAL)

ADDRESS _____ CITY _____

WHEN REMOVE _____ BY _____ (METER SUPT.)

REMOVE METER ORDER DATE OF ORDER _____ 19____

DESCRIPTION OF METER ON BACK — TO BE ENTERED IN OFFICE AND CHECKED BY REMOVER

DATE REMOVED _____ 19____ TIME _____ M.

READING OUT _____ BY _____ (REMOVER)

REMARKS: _____

ENTERED IN READING BOOK _____ 19____ BY _____ (ALSO CHECK METER DESCRIPTION)

Top: Fig 1—Meter Test Record Card. Middle: Fig. 2—"Set Meter Order" Card. Bottom: Fig. 3—"Remove Meter Order" Card

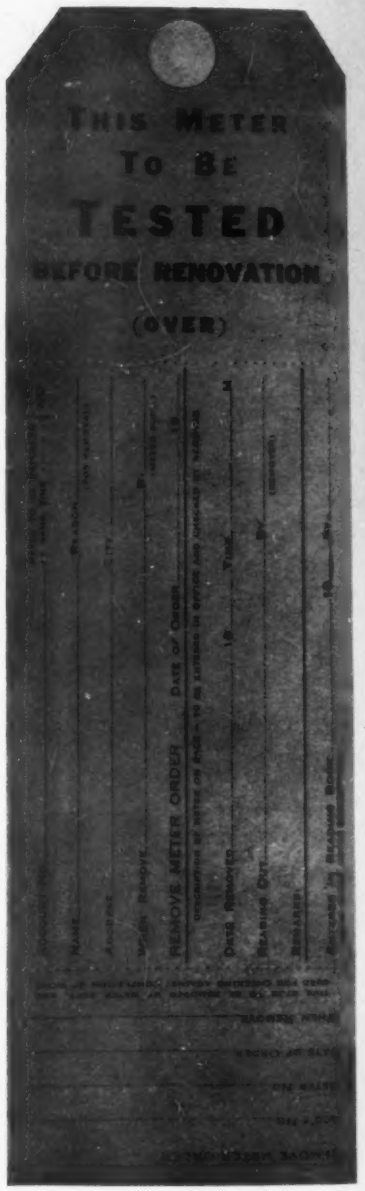
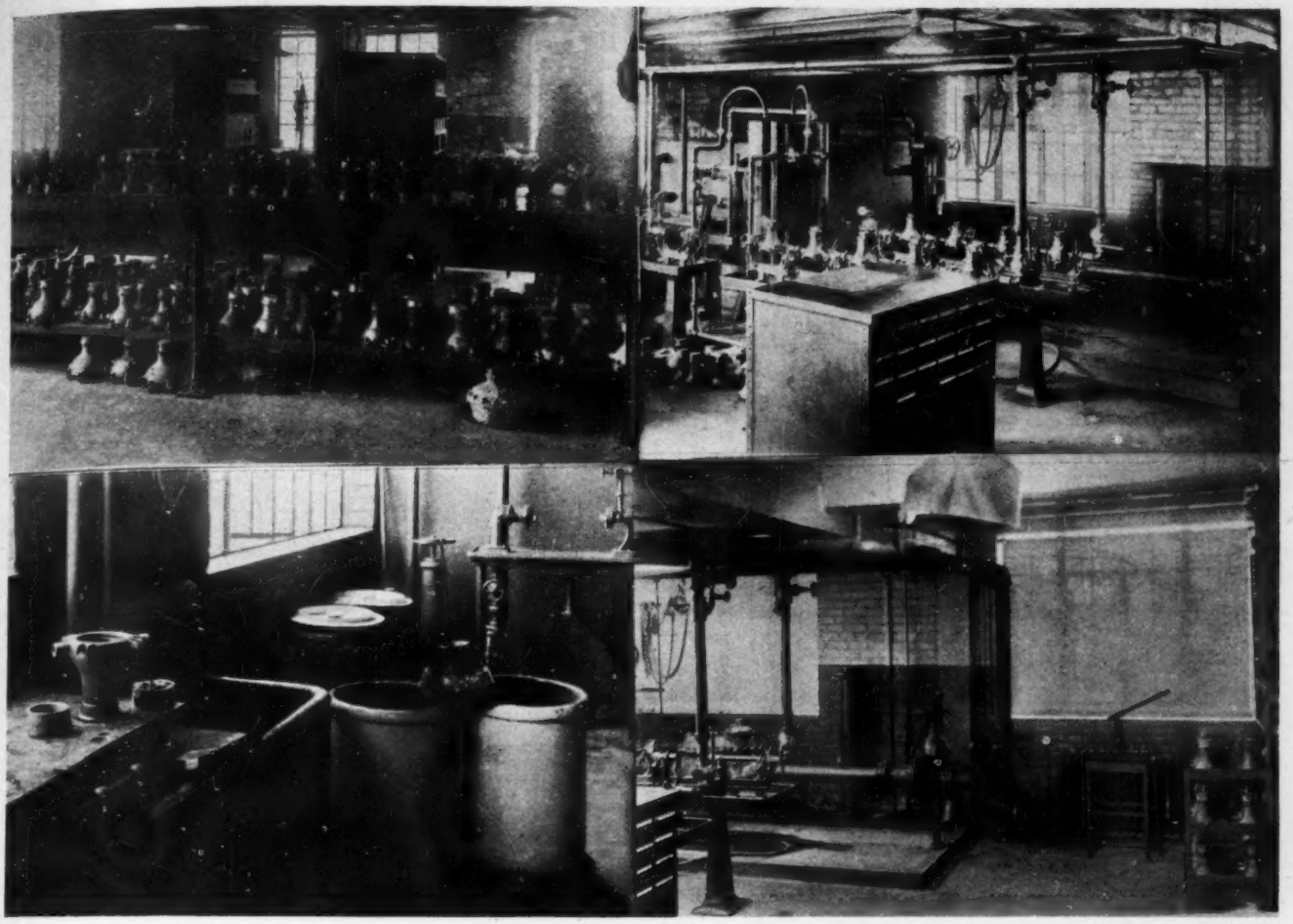


Fig. 4—"Remove Meter Order" Card Used in Case of Special Test



Top, Left: Fig. 5—Bench in Meter Maintenance Shop of New Rochelle Water Co. Bottom, Left: Fig. 6—Cleaning Solution Crocks in Meter Shop. Top, Right: Fig. 7—One of Five Benches in Meter Shop. Bottom, Right: Fig. 8—Pressure Test Pump

take care of five meters each from ⅝ in. to 1 in. in size. These two benches are in practically constant use. While they are equipped with only one pair of volumetric tanks of 1 cu. ft. and 10 cu. ft. capacity respectively it will be noted that the piping is so arranged that one bench can be served by the small tank while the other is using the large tank or vice versa. Then there is a single testing bench which will take meters from ⅝ in. to 1¼ in. This bench is used for special tests and has the same outlet piping as is used for the second of the two multiple benches. There is then one more single testing bench for 1½ in. and 2 in. meters. This bench will discharge into either one of the steel tanks or the concrete tank as desired. The steel cabinet in the foreground contains change gears.

In the meter testing room, the water pressure is only about 40 lb. Some of our meters in service are subjected to pressures of 150 lb. and complaints were coming in from such places that the meters we installed would leak. To overcome this we installed a hand operated pressure pump shown in Fig. 8. Before removing the meters from the test bench the pressure is raised to about 200 lb. and the meters inspected for leakage. Since adopting this method we have had no further complaints.

After the meters have been tested each one is sealed. Then the bottom caps are painted and the meters are then moved to the spray booth. This equipment is illustrated at the top of page 107. The booth is equipped with a motor driven turn table revolving at the rate of 9 r.p.m. and a suction fan to remove the surplus spray. The body of the meter is sprayed with gold and the cap with aluminum making the meters conform to the standard color combination of the Community Water Service Company. The meters are painted with gold at the rate of about 240 per hour, and with aluminum at about 300 per hour, and present a fine looking job when completed.

While we have no exact information as to the increase in revenue produced as a result of our meter maintenance, it is a significant fact that at the present time complaints of high bills increase in proportion to the number of meters changed. It appears that in almost every case there is some appreciable increase in registration. However, after all the meters in the system have been changed and regular maintenance is in full swing there should be no more difficulty from this source. We feel certain that the systematic maintenance of meters will more than pay for itself.

Many of the procedures outlined above were developed by U. S. Rutan, Meter Expert of the Community Water Service Company, and the efficient operation of the shop is due to the energetic work and cooperation of Charles W. Neydl who has direct charge of meter repairs in the shop.

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RHINELANDER, WISCONSIN, PURCHASES 300,000-GAL. WATER TANK.—The new 300,000 gal. water tank to be erected at Rhinelander, Wisc., has been contracted for. The Pittsburgh-DesMoines Co. of Neville Island, Pa., were the successful bidders.

Guy H. White, President, Southeastern Section, A. W. W. A.

ANNUAL MEETING SOUTHEASTERN SECTION AMERICAN WATER WORKS ASSOCIATION

W. H. Weir, Secretary, Southeastern Section, A. W. W. A.

THE Atlanta-Biltmore Hotel was the meeting place for the Southeastern Section of the American Water Works Association March 22nd-24th. The lack of a larger attendance from Alabama may have been due to the devastating tornadoes that swept a part of that state just prior to the meeting. The attendance was nevertheless very fair—166 registering with probably 175 total attendance.

The visit one afternoon to the Atlanta filtration plants was instructive and extremely interesting. W. Z. Smith, General Superintendent, W. M. Rapp, Operating Superintendent, and Paul L. Weir, Superintendent of Filtration of the Atlanta Water Department had prepared a number of exhibits and demonstrations of how things are done in Atlanta water works practice. Among these were methods of removal and cleaning of old filter sand and gravel, cleaning filter sand in place, of revamping strainer systems, making water service pressure and flow surveys on private property (from the main to roof) and the cutting of large diameter cast iron pipe by a system devised by Mr. Rapp and illustrated in the picture accompanying this report. The only regret of the writer is that more time had not been allotted for a longer inspection of these several operations and others which time did not permit demonstration of.

Some Atlanta Water Works History

Few if any American cities boasted of mechanical filters prior to the Atlanta installation of the mechanically washed Hyatt sand filters. It took about three men, and a boy to keep these units operating. No chemical treatment was involved and the sand beds acted merely as mud and trash strainers. Twelve of these units manufactured under Hyatt patents in America by the Newark Filtering Company were installed in 1886 and remained in service until as late as 1922. Chemicals were used in conjunction with them perhaps since 1893 when the first 4 Continental pressure filters were installed.

An Early Application of "Activated Carbon"

Interestingly enough, Superintendent Smith told the visiting members that he could boast of a very early use of "activated charcoal" in the Atlanta system. In filling the Continental filters the expedient of mixing charcoal with the sand was hit upon. The supply of this carbonaceous material had been collected from the early wood burning locomotives, which some of our readers will recall were equipped with those ungainly but useful "fly catchers" on the smoke stacks. These in fact were spark catchers and at the end of each run perhaps a half-barrel of charcoal cinders would be dumped out. This charcoal, "activated" in the "wood burners" somewhere between Atlanta and Savannah, served as a good filler for Atlanta filters.

The Meeting

The meeting was opened by Chairman Guy C. White, of Columbia, S. C., then followed the Mayor's address of welcome and a short introduc-

Meeting of the Southeastern Section American Water Works Association, Hotel Biltmore, Atlanta, Ga., March 22-24

B. C. Little, Secretary, A. W. W. A.; Ross L. Dobbin, President, A. W. W. A.; Guy H. White, President, Southeastern Section, A. W. W. A.

tory talk on **"Water Supply and Public Health"** by **Dr. T. F. Abercrombie,** Director of the Georgia Department of Health. He said that surface water was the principal source of supply in the northern part and ground water was mostly used in the southern part of Georgia. The Engineering Division of the Health Department was organized April 1, 1920. He said there now existed 275 public water supplies in Georgia and that entailed a considerable amount of supervision. Sewage treatment, he said, was becoming increasingly important as a safeguard to water supplies and public health generally.

Ross L. Dobbin, Manager of Utilities at Peterborough, Ontario, and President of the A. W. W. A., was present and addressed the Southeastern Section as did **B. C. Little,** Secretary of the parent association. Mr. Dobbin said that he, being a Canadian, felt more than commonly honored to be President of the parent association. He liked the South and what it had to offer a Canadian guest. "Beek" Little had said that the difference between New York State and Georgia "was just about $18.00 a gallon" but he had found that the Southeast and Canada were much closer akin in matters of that kind and he felt at home because of this as well as for other reasons. Ross Dobbin in a sincere and matter of fact style then made a sterling talk that brought Canada and the United States even closer together than ever before—i. e., in so far as **water** is concerned at least.

Paul L. Weir, Superintendent of Filtration, Atlanta Water Works, reviewed the methods of turbidity measurement and gave a **"Demonstration of Turbidity Measuring Equipment."** He exhibited and described special equipment developed in the Atlanta plant for measuring turbidity between 1 and 10 p.p.m. He said that one could predict taste occurrence by observing turbidity of the coagulated and filtered water because increasing turbidity indicated inefficient coagulation and passage of taste producing products through the filters.

"Developments in the Application of Powdered Activated Carbon in Water Purification" were summarized by **F. E. Stuart,** of the Industrial Chemical Sales Company.

Mr. Stuart, brought up to date the successful use of powdered carbon in taste and odor removal from water. Costs of treatment at several important plants were given. He said that carbon carried a positive electrical charge and should therefore be expected to absorb the negatively charged impurities in water. That included compounds resistant to removal by coagulation and in fact powdered carbon had been proven of value in improving coagulation and also the efficiency of color removal by alum. In at least one plant swamp water had been more perfectly coagulated and color removal improved by adding carbon to the raw water. Alum had been saved and the lime dosage reduced. The addition of lime to the filtered water had heretofore caused color to be increased but since starting carbon application to the raw water this undesirable feature of pH correction had been eliminated.

Mr. Stuart spoke of sludge recirculation at softening plants and the fact that carbon application had removed the objection to this practice on the score that whatever bad taste had been imparted to the water was eliminated and that a portion of the applied carbon had thus been used over again in sludge recirculation practice at softening plants. He said that carbon could be used along with the prechlorination without interference. Strangely enough the residual chlorine had increased rather than the reverse when carbon was applied ahead of the prechlorine application, but that the carbon deposited on the filters would promptly remove the excess chlorine during passage through it and with it any taste and odor producing compounds which might remain otherwise. He believed that prechlorination in conjunction with powdered carbon application to the raw or settled water was the overall most efficient procedure to follow in taste and odor elimination or incidental benefits. He referred to the successful practice of mixing carbon with powdered alum and feeding the mixture (2 per cent carbon) through a single dry feeder.

Experience seemed to indicate that where ammonia was used in conjunction with prechlorination the residual chlorine would only in part be removed in passage through carbon on the filters.

T. E. Fussell, Superintendent, Water Works at Griffin, Ga., reported successful use of powdered carbon (1.4 p.p.m.) for eliminating swampy and

W. Z. Smith (Left), General Superintendent, and W. M. Rapp, Operating Superintendent of the Atlanta Water Department (Mr. Smith Was in the Midst of Explaining Sand Renovation Operations at the Filtration Plant)

H. F. Wiedeman, Director, Southeastern Section, A. W. W. A.

Paul L. Weir, Superintendent of Filtration, Atlanta, Ga.

woody tastes. **W. B. Sellars,** of Rome, Ga., raised the question about efficiency of wood charcoal to which Mr. Stuart replied that it would prove effective if added to the extent of about 9 times the weight of activated carbon required to do the same work.

H. G. Menke reported an instance in which superchlorination of raw water and carbon application just ahead of the filters had proven the most effective method of taste elimination in a problem he had dealt with.

(Editor's Note:—Mr. Menke's experience has also been that of others dealing with difficult taste problems—notably the recently published experiences at Rahway, New Jersey.)

"Wells and the Part They Play in Our Water Supplies," by **W. R. McGrew,** of Thomasville, Ga.

Mr. McGrew, a well driller, said that the first drilled well put down in America was that at Buffalo Lick, Virginia (1808), which was only 58 feet deep. Recently a well in California was drillled to a depth of 10,030 ft. and water was found at the bottom. Temperature increase had been on the average 1 deg. F. for each 55 ft. of depth the hole is drilled. Mr. McGrew said that wells ending in sand formation required expert knowledge of drilling and of methods of keeping sand out of the well. He believed that well drillers should be licensed by the state and forced to keep accurate logs of all wells put down. It would be particularly valuable to prepare a graphic log for every well. The well pump he thought should be specified and supplied through the well contractor in order to preclude division of responsibility between the pump contractor and the driller. He said that frequently putting down a well in a selected location would preclude the necessity of putting increased pressure on the mains or the enlargement of the mains.

At present there are 6,000 or more municipalities served by well supplies in the U. S. A.—Brooklyn, New York, being the largest with a per day consumption of 100,000,000 gallons.

H. S. Hamilton, a well driller of Breman, Georgia, spoke in favor of compulsory log keeping and licensing of drillers. **L. M. Clarkson,** Chief Engineer of the Georgia Department of Health discussed casings and proper sealing of casings. **Mr. McGrew** said that the most effective seal was secured with a tapered ring of lead driven into a point near the terminus of the casing.

"Water Softening at Thomasville, Georgia," by **Lowell Cady,** of Wiedeman and Singleton, Engineers, Atlanta, Ga.

Mr. Cady said that the lime soda process had been installed at Thomasville, Ga. (15,000 pop.) to soften a 12 gr. per gallon well water to 4 gr. per gallon total hardness. The plant treats 1.5 million gallons per day at a cost of $39.05 per m.g.—that comprising $14.83 for chemicals, $13.14 for interest and depreciation and $11.08 for labor, power and incidentals. The figure which had been predicted in estimating had been $40.35 per m.g.

The plant was designed for 30-minute mixing in mechanical agitators followed by primary carbonation, thence through a Dorr clarifier (1.5 hours), an intermediate carbonation chamber, a settling basin (4 hours), sand filters and final carbonation to stabilize the finished water. Super lime treatment is given a portion of the water which joins the other portion in No. 2 mixing tank. Alum is added to the water beyond the Dorr clarifier. Carbon dioxide is taken from the boiler house stack, is scrubbed, and compressed through an Ingersoll-Rand compressor (capacity 100 cu. ft. per min.) operated at constant speed. Air is admitted to regulate the carbon dioxide input to the water.

Mr. Cady said that unsoftened water was being used for filter and basin washing, dry feed machine operation, etc., which amounts to 6.6 per cent of the total water pumped. The finished water has 38 p.p.m. noncarbonate hardness and 30 p.p.m. total alkalinity (carbonate and bicarbonate hardness) making a total of 68 p.p.m. soap hardness. The pH value of the filtered water being 9.1 requires final carbonation to avoid scale depositions within the mains, meters, etc.

The annual cost of softened water is $11,000 and soap saving, reduced plumbing repairs, lower cost of operating privately owned zeolite softeners, etc., amounts to an estimated net saving of $23,300 per year to the citizens of Thomasville.

D. Rhett Pringle, Superintendent Water Works, Thomasville, confirmed soap saving and cost of zeolite softening by saying that two institutions save $1,200 per year each and a power plant saves $800 per year. He said that he wished to compliment Mr. Cady and his firm on the job done.

"Our Streams and Their Flow," by **E. D. Burchard,** District Engineer, U. S. Geological Survey, Asheville, N. C.

Mr. Burchard, discussed the importance of keeping stream flow records. Without such records, predicted yields from water sheds was a hazardous per-

Cutting 30 In. Class D Cast Iron Pipe at Atlanta. The Demonstration of This Method, Devised by Mr. Rapp, Was Given at the Filtration Plant. Note the Holes Drilled Entirely Around the Pipe

formance. For example, observations had revealed as much as a 500 per cent difference in yields from two adjacent watersheds in North Carolina. He spoke of the effect of vegetation causing decrease in stream flows during daytime. Transpiration was almost wholly responsible and at night the flow would increase. In late afternoon only 65 per cent to 85 per cent of the maximum flow rate for the 24 hours will frequently be observed.

Mr. Burchard told of an interesting observation of temperature effects where the colder turbid freshet water entered a long impounded lake and had traveled unseen along the bottom to the dam 30 miles down stream. All the time the water on the surface of the lake was clear and without warning the muddy water appeared at the dam.

W. R. King, Engineer of the Chattanooga District

The First Imhoff Tank to Supply Gas Used for Household Heating and Cooking, Peachtree Creek Sewage Plant, Atlanta, Ga. C. C. Hommon, Then Chemist in Charge, Used the Gas Collected From the Central Vents As Fuel in His Home About 20 Years Ago

said that 0.1 cu. ft. sec. (45 g.p.m.) per square mile of drainage area, the customary estimate of safe water-shed yield, had been proven unsound because several streams in Tennessee had dropped to less than half the assumed safe yield of 45 g.p.m. per square mile. Some had dropped to 3 g.p.m. per square mile. Kentucky streams of important size had dropped as low as 5 g.p.m. per sq. mi. during the drought and smaller ones had gone completely dry.

L. H. Enslow cited a parallel condition to the 30-mile lake short circuiting. At Spartanburg while he was operating the filter plant the raw water reservoir had on many occasions in hot weather shown the same undertravel of turbid freshet water to the old filter plant intake. In Panama, the effect of temperature differences played an important part in behavior of settling basins and reservoirs.

"Spartanburg Water Works and Its Byproducts" was the title of a joint paper by **R. B. Simms** and **J. K. Marquis** and presented by the latter.

Mr. Marquis called attention to two unusual features of the Spartanburg (S. C.), water works system. The first was the generation and sale of electric power by utilizing available head from the impounded waters. Power above plant requirements was sold to the power company. The second was income from sale of filtered water to an industrial plant (cotton mill and bleachery) during off peak demand.

Deducting interest on the added investment for the higher dam required for power production they had figured an annual net profit from power averaging $8,564 per year for 5½ years of operation.

The sale of water to the bleachery, Mr. Marquis said, had paid for installation of pipe line and pumping equipment ($20,000) the first year. The monthly income had been something over $743 per month since. The bleachery had a 3-day storage reservoir and water is delivered to it during the night and over week-ends only. Selling power to the power company at ½ ct. per K. W. H. being less attractive than using it to pump water, more off peak water users would be welcomed in order to convert low yield power into higher income producing performance.

A third byproduct of the water works had been the construction and operation of a 12 m.g. artificial lake 13 miles out of town as a "swimming hole" and recreation ground. The only profit that this activity had yielded had been a wonderful attitude of citizens toward the water works management, and Mr. Marquis said that had meant a great deal to them. A man paying his water bill, with a free annual pass to Rainbow Lake, for the asking, somehow would feel that he was getting something in the way of a rebate or a sort of bonus or dividend. At the same time he was absolutely assured that he would "Swim in Drinking Water" at Rainbow Lake.

"Water Works Accounting," by **H. H. Gardner,** Atlanta, Ga.

Mr. Gardner referred to accounting as being a "tool," useful in water works practice as any other tool would be and the bookkeeper was the artisan to use that "tool." The system employed would necessarily be designed to meet specifications laid down by the management. With such specifications, professional accountants could then operate to meet these requirements. Mr. Gardner then cited some of the practical applications of accounting and his understanding of the matter in general.

J. H. McClure, Superintendent at Chester, S. C., said that he had been in other business before becoming a water works superintendent. He had been, and was still, trying hard to figure accurately what it costs to produce water. He said very few managers had any correct idea of what water cost the municipality and some concrete answer was highly desirable.

"Information on Water Works Problems and Where It Can Be Found" was the subject assigned **L. H. Enslow** who briefly covered the most effective way of securing information on water works problems. He stressed the advantages derived from attending Water Works Short Courses being offered in a number of colleges or universities annually, and now being planned for Georgia Tech within the year. Attending water works meetings was he thought most beneficial and complementary to the Short Courses. Contacts, visits to other cities and plants, subscribing to journals and *reading* them, and close attention to demonstrations of water works practice, such as were given at the Atlanta plant, were all sources of information. The man who wanted information

really did not need to be told how to get it. The fellow who attended meetings was that kind as a rule, and therefore the subject was somewhat out of place in this meeting.

In order to place on record a list of reference works and helpful handbooks, etc., a list of these had been prepared with the help of representative men in the water works and sewerage field and that list would be published in the Southeastern Water Works Association Proceedings. Interestingly enough, more than one manager or superintendent had suggested to him the value of manufacturers' catalogs as sources of information aside from being merely useful in purchasing or specifying equipment. The most used ones he was including in the list of references works. So many bulletins and handbooks prepared by manufacturers for free distribution were available that a man could build up a fair library with little or no expense. Methods of filing useful data and information were given.

Sewage Disposal Practice Discussed

As is the case lately with most water works meetings, sewage was also brought in for discussion. Since recent practice has been to turn over sewage plant operation to water works personnel it is becoming a matter of importance to water works men to familiarize themselves with sewerage matters and sewage treatment.

"Some Trends of Municipal Sewage Disposal Practice" by **W. Donaldson** of Fuller and McClintock, Engineers, New York.

Mr. Donaldson said, that water works men had a dual interest in sewage treatment. First, for protecting water supplies, and equally as important, as citizens interested in cleanliness of streams and advances made in municipal housekeeping. Lack of proper treatment of sewage and industrial wastes had unfortunately caused entire abandonment of the original sources of water supply in several instances already and therefore it was a matter of some importance to prevent stream pollution before too late to correct it easily.

Mr. Donaldson, said that sewage treatment was undergoing rapid development and that even now it was practicable to select a type of treatment best suited for the local requirements to be met and the available funds. A variety of processes or combinations of these were available and yet there were many possible improvements or refinements now under study and development. He reviewed and evaluated the several available processes and combinations of such. He said that sprinkling filters still held a solid and dependable position but were giving way to the activated sludge process in the larger cities. He spoke of the several methods being applied to reduce the operating cost at activated sludge plants, which at present was admittedly higher than desired. Small activated sludge plants suffered a great deal more from operating cost and difficulties than did the larger ones. He referred to developments with paddle aeration in combination with diffused air and other measures such as raising diffusor tubes above the floor of the aeration tanks, or aeration wholly by mechanical devices.

The recent appearance of an improved process depending solely on chemical precipitation and mechanical straining of solids from the settled liquor plus sludge dewatering by vacuum filtration deserved consideration. The process developed by W. C. Laughlin for Dearborn, Mich., would serve to produce results not now attained by any proven process, in that it would serve to produce purification superior in appearance and organic matter removal to that obtained by ordinary sedimentation. The use of moderate quantities of chemicals lent attraction to the economics of the process.

Mr. Donaldson referred to sludge disposal practice now existing and the developments with mechanical filtration. And very probably incineration of the resulting sludge cake would prove the most satisfactory final solution of the sludge problem. The process of dewatering on vacuum filters had already proven itself sufficiently attractive to warrant its use at several existing plants and two or three proposed plants. The disposal of the sludge cake remained an open question but with fertilizer as cheap as at present there would probably be no further developments toward producing it from sewage solids for the time being.

In discussing sewage chlorination, Mr. Donaldson commented on the several recently proven uses of chlorine and particularly to the newer use of lime and chlorine mixed to produce hypochlorite and thus increase the efficacy of the chlorine in retarding biological activity in sewage and in streams receiving the chlorinated sewage or effluents. Large scale installations of the Lime-Chlorine process at Dayton, Ohio, and Baltimore, Maryland, had been in operation during 1931 and its use was proposed at Middletown, New York, and elsewhere. The use of chlorine in one ton containers had made chlorine handling a less troublesome matter and the cost of chlorination had been reduced appreciably also.

Mr. Donaldson's paper was listened to with interest and the author was complimented from the floor for the very excellent presentation of the subject. Discussion and questions followed which space does not permit reproduction of in this "digest."

Resolutions and New Officers

Resolutions were passed lamenting the deaths of four members of the Southeastern Section—E. C. Morrison, J. G. Bostwick, C. W. Mickle and R. M. Clayton—the last a past president of the A. W. W. A.

New officers elected were:

President: H. Perry Powell, Griffin, Georgia.

Vice-President: J. K. Marquis, Spartanburg, S. C.

Secretary-Treasurer: W. H. Weir, Atlanta, Georgia.

New Directors: J. F. Pearson, Orangeburg, S. C.; G. R. Pringle, Thomasville, Georgia.

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DELAWARE VALLEY UTILITIES BUYS 9 WATER COMPANIES.—The New Jersey Board of Public Utilities has authorized the Delaware Valley Utilities Company to acquire from the National Water Works Corporation the capital stock of nine water companies in the Delaware River Valley. The companies involved and the number of shares of stock to be transferred are:

	Shares
Frenchtown Water Co.	1,000
Ideal Beach Water Co.	189
Riverton Water Co.	1,750
Junction Water Co.	436
Laurel Springs Water Co. (Pfd.)	3,400
Laurel Springs Water Co. (Common)	550
Tuckerton Water Co.	440
Jamesburg Water Co.	300
Washington Water Co.	1,179
Barnegat Water Co.	215

Group of Visitors at Madison-Chatham Sewerage Plant

17th ANNUAL MEETING NEW JERSEY SEWAGE WORKS ASSOCIATION

THE 17th annual meeting of the New Jersey Sewage Works Association was held at Trenton, N. J., March 17 and 18, 1932, with President Floyd A. Hoffman of Morristown, N. J., presiding.

Because of illness, H. P. Croft, Chief Engineer of the New Jersey Department of Health, could not attend and his presence was missed by his many well wishers. P. N. Daniels, in charge of arrangements and entertainment, was voted thanks and appreciation for the handling of the meeting. The "speechless dinner" was up to par as were the exhibits of manufacturers and the attendance of 190 at the meeting.

Officers elected for 1932-33 were: President, Courtland H. Shute, of Glassboro, N. J.; First Vice-President, W. Mallilieu, Boonton, N. J.; Second Vice-President, Leroy Forman, Trenton, N. J.; Secretary, John R. Downes, and Treasurer, E. P. Molitor.

Technical Papers

The most interesting paper presented was that descriptive of **"The Activated Sludge Plant at London, Ontario,"** by **W. M. Veitch,** Engineer of Sewage Disposal, London, Ontario.

There are several unusual features in the design of the plant and its operation. Outstanding among these Mr. Veitch listed the following: The air header piping is all welded and is submerged in the aeration tanks. Returned sludge is withdrawn through the tank drain pipes. The plant is constructed without expansion joints. Excess sludge is removed along with crude screenings by discharge of sludge to the crude sewage ahead of mechanically operated fine screens. The screen used is a special design of the author's and consists of paddles or leaves rotating through the sewage. One-eighth inch mesh wire covers these leaves and the mixture of screenings and sludge is jarred loose into a receiver when the heavy frames of the leaves (rotating) flip over and "bangs" against a striking bar. There are no preliminary settling tanks in the plant. The mixed screenings plus excess sludge containing 87 per cent water (to be dewatered by filter pressing to about 75 per cent moisture) is now burned in an incinerator which requires but little auxiliary fuel. In a test the fine screening-operation had removed 9 per cent suspended solids from the crude sewage and 119 lb. of solids as excess sludge per hour.

For burning fine screenings at London, Mr. Veitch said that the incinerator had a grate area of 3 sq. ft. and drying area above of 4 sq. ft. In this they had burned 1300 lb. wet screenings per day per square foot of grate area. The screenings contained 87 per cent water. The cost was 50 ct. or less per ton.

Mr. Veitch said that he believed that air economy has resulted from use of precast air diffusor plates but that perforated pipes had been satisfactory also until the holes had become plugged due to sludge entering when the air was off. The air consumption had been 0.7 to 1.0 cu. ft. per gallon.

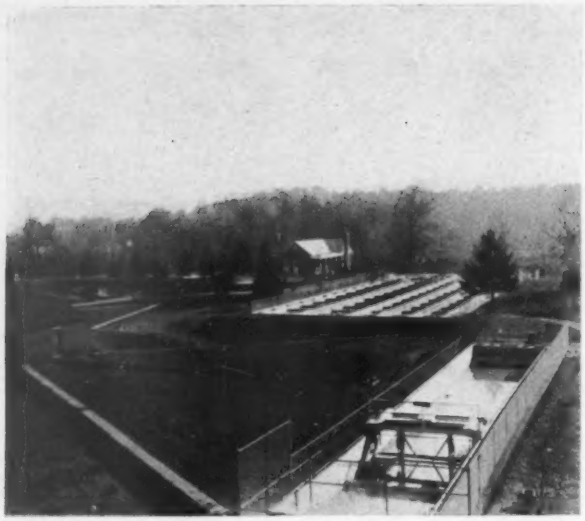
He employs an unusual procedure in aeration. The theoretical aeration period is only 1.8 hours whereas the sludge is reaerated for 8 to 12 hours. In that way about 55 per cent of the solids removed are destroyed by "wet burning" during aeration and reaeration. Even so, the power requirement is but 15 hp. per million gallons.

Another interesting operating "kink" has been the use of chlorinated lime (bleaching powder) applied at intervals to the reaerated sludge whenever the sludge begins to lose color and density in the aeration tanks. The author reported that this scheme has proven a valuable procedure in correcting what otherwise would grow into a bad condition.

Mr. Veitch gave cost data indicating that the new 6 m.g.d. capacity plant had cost $4.00 per capita to build. The operating cost was $10,000 per year when treating 4 m.g.d. flow, which amounted to but $6.25 per m.g., because of the very moderate power cost of ¼ ct. K. W. H. Three compressors of the horizontal type (Ingersoll-Rand) supplied the air under 7 lb. pressure and that arrangement had proven very flexible. The air headers had been submerged in the aeration tanks to reduce first cost, and more particularly for cooling the air and for oil removal.

Wellington Donaldson, in discussion, said that he had been impressed with the London scheme of dewatering and incineration of the excess solids and crude screenings which had been practiced for the past 8 months. It was a step in the proper direction and one now being worked on at Chicago, Milwaukee and elsewhere. The use of such a short aeration period (1.8 hours) and such a long reaeration period (8 to 12 hours) was quite novel in activated sludge practice.

Weston Gavett said that he was impressed with the remarkably low costs at London and was interested to learn that the horizontal compressors usually believed to produce oil trouble had proven so satisfactory. At the Morristown, N. J., plant they were using copper tubes with perforations 0.04 in. diameter but had not experienced clogging and was surprised to hear that ⅛ in. holes at London had clogged. Mr. Gavett spoke of the importance of sludge density as affecting settling rates and thought that perhaps the use of secondary final settling tanks



New Sewage Disposal Works at Morristown, N. J. Hardinge Clarifier in Foreground. Office, Laboratory and Needham Blowers in House Beyond Aeration Tanks.

(double settling) might prove valuable in many plants.

DeWitt Vosbury, said that it was no simple matter to design and successfully build a plant without expansion joints and the absence of these in the London plant had impressed him greatly and submerged welded piping was another worthwhile development. He was impressed with the fact that we knew less about the activated sludge process now that we once thought we did. One theory that had appealed to him was that of adsorption of colloids from the crude sewage by the floccular activated sludge. In a way it seemed to be a matter of coagulation due to electronic changes brought about by introduction of the active sludge and the liquid surrounding it.

"The Activated Sludge Plant at Madison-Chatham, New Jersey," was described by that "Maestro" of sewage treatment, **Paul Molitor.** Mr. Molitor began his career as operator of the first Imhoff tank installation in America over 21 years ago. On the location of this same plant and utilizing these same Imhoff tanks as preliminary units a modern activated sludge plant has been constructed over which Mr. Molitor presides as superintendent. To prove that he believes in sewage treatment and its future he has two sons operating sewage works and a third preparing for the same vocation. This serves as an introduction of one of America's pioneer sewage works operators.

Mr. Molitor said that he had experienced less difficulty in operating the present activated sludge (separate digestion) plant than he had with the old Imhoff tanks, contact beds and sand filters. The old Imhoff tanks now serve as sedimentation units and sludge is transferred to separate digestion tanks. The aeration tanks are equipped with Norton diffusor tubes located 4 ft. above the tank bottom. The air consumption had been but 1.3 cu. ft. per gallon on the average and the results had been good. The effluent had contained an average of 8.3 p.p.m. suspended solids. For best results they had carried between 20 and 60 per cent sludge by volume in the aeration tanks (1-hour settling) or about 2,700 p.p.m. suspended solids by weight. The effluent leaving the Hardinge clarifiers was being chlorinated and passed through a final settling tank of the Imhoff design. The 20 minute detention in that unit allowed more solids to settle out and thus the effluent was further improved. "Bulking" had been experienced only infrequently in the clarifiers but never in the final tank after chlorination.

The Norton tubes had become clogged somewhat but were cleaned by immersion in dilute nitric acid and at very moderate expense and with but little difficulty in removal and replacement without necessitating stopping operations of the aeration tanks.

Mr. Molitor said that the power requirement had been 26 hp. per million gallons. The plant treats 1.12 m.g.d. average flow with only two shifts of operators. The current cost was 2.33 ct. per K. W. H. and the total operating cost of $36.85 per m.g. could be broken down as follows:

	Per M.G.
Power	$11.05
Supervision	15.60
Labor	6.80
Supplies	3.40
Total	$36.85

By test the plant effluent had a B. O. D. value of 7.5 p.p.m. before chlorination and leaving the final tank (after chlorination) had a B. O. D. of only 5 p.p.m. (98.5 per cent removal by the entire plant). Of peculiar interest, was the very low dissolved oxygen content of the effluent leaving the clarifiers (0.4 p.p.m.), but even so the quality of effluent had continued satisfactory.

Wellington Donaldson, in discussion, said that the ratio of sludge weight to volume was of primary importance in evaluating sludge quality. He pointed out that such low oxygen content of the effluent was indicative that the margin of safety was not very great and that the air input was probably the minimum that would produce satisfactory results. He thought it playing on the danger line so to speak.

Weston Gavett said that the low air requirement (1.3 cu. ft./gallon) at Mr. Molitor's plant had proven the efficiency of aeration with diffusors located 4 ft. above the floor of the aeration tanks. He commented on the value of the secondary settling tank beyond the final clarifiers.

"Operating Experiences at the Red Bank, New Jersey, Plant" were recounted by **E. M. White,** Municipal Engineer, Red Bank, N. J.

Mr. White described the separate sludge digestion plant with Dorr clarifiers and one Dorr equipped digestor 20 ft. deep. The plant began operating February, 1930. To date the most worrisome items had been sludge pumps and sludge lines. The original centrifugal had been replaced by a diaphragm pump. He stressed the need of ample flushing facilities for sludge lines and pumps.

Aeration Tanks, Madison-Chatham Plant, Chatham, N. J. Tanks Equipped With Norton Co. Cylindrical Diffusers Located 4 Ft. Above Floor of Tanks.

Digested sludge at Red Bank contains 90 per cent moisture and 54 per cent ash on a dry basis. He said they had experienced foaming troubles which had clogged the gas meter. The foam had been run to the covered sand beds where it dried quickly without nuisance. Lime had been added to correct foaming but none since.

Dry feed chlorination of the plant effluent as first installed had proven a failure and now solution feed chlorination is used. An automatic chlorinator applies the major dosage to the crude sewage. A manually controlled machine adds a slight dose to the settled sewage for safety but prechlorination alone can be depended upon. Mr. White, said that he had found prechlorination more economical and of great value in improving the operation of the clarifiers. Since starting prechlorination, gas lifted solids in the effluent had disappeared and the scum accumulating on the tanks had been reduced to next to nothing. Mr. White described an ingenuous scheme of water jets used to sweep grease and oil scum to skimming troughs along the sides of the clarifiers.

S. A. Kowalchik in discussing Mr. White's paper called attention to the hazards around sewage plants. He thought it unwise to place a house over sludge digestors and particularly not to house heating equipment in structures on top of digestors. He warned that sludge drawing from tanks should be regulated to avoid sucking air into the tanks.

"Sludge Operations at the Baltimore, Md., Sewage Works," were reviewed in a paper by **E. C. Cromwell** Principal Sanitary Chemist, Baltimore Sewage Works.

Mr. Cromwell reported that solids from the plain settling tanks is added to the separate digestion tanks (no stirring mechanism) in the ratio of 1 to 10 of sludge held within the tanks. One foot of solids added to each digestion tank in rotation meant that each tank received solids every tenth day but in Summer that program can be doubled. Sludge temperature varies between 68 and 71 deg. F., and pH values of 6.7 to 6.9 produced satisfactory digestion.

The sludge drawn has averaged 4.4 cu. yd. (90 per cent water content) per million gallons of sewage treated. The dried sludge (70 per cent water content) is 5 to 6 in. thick when removed by hand from the sand beds. It contains 2.2 per cent available nitrogen a 0.5 per cent phosphonic acid (P_2O_5). The present sludge demand by farmers and others is 50 per cent more than is produced. No charge is made for the sludge taken from old lagoons or the beds. Mr. Cromwell reported that sludge dewatering tests at Baltimore, using various mechanical filters showed promise and were being continued.

In the discussion it was reported by one member that sludge compositing produced too great acidity for use in greenhouses. Mr. Cromwell reported that the so called "fresh" sludge at the Baltimore plant, when transferred to the digestors, had pH values between 4.4 and 4.8 but he had not heard of acid production interfering with use of digested sludge.

"Operating Hazards and Safety Measures" in sewage disposal was discussed by **H. E. Newell,** Engineer, National Board of Underwriters.

Mr. Newell, said that the existence of hazards in connection with sewage treatment had surprised the general public and had caused some concern to the insurance interests. He referred to the findings of Coward & Jones (Bureau Mines Bulletin No. 279) that explosive mixtures of air and methane gas (CH_4) would result when between 5.3 and 13.87 per cent methane was present. Other investigators had reported the low limit for explosiveness to be air containing 5.6 to 6.0 per cent methane and the upper limit 14 per cent. Methane, he said, was odorless and weighed about one-half as much as air and sludge gas contains from 70 to 80 per cent. Mr. Newell, thought that electric motors used where sludge gas might exist should be of the type designed for use in hazardous atmospheres. He referred to the possible production of explosive nitrogen trichloride (Ncl_3) when chlorine and ammonia mix.

The dangers resulting from wasted gasoline from cleaning establishments and crank case oil in sewers was brought out in the discussion.

L. H. Enslow recounted the severe explosion in Los Angeles sewers traced to oil refinery wastes, and commented on the fact that the limiting concentration of 5.3 to 14 per cent methane required to produce explosive mixtures with air had perhaps been the reason why such a limited number of explosions had been experienced at sewage works. He had an interesting experience when addition of lime to a digestor had actually absorbed carbon dioxide to such an extent as to cause a partial vacuum to form and air was sucked into the digestor as a consequence. Needless to say the contents of the tank had been acid prior to the liming.

Notes on **"Sludge Digestion"** were presented by **John R. Downes,** Supervising Engineer of the Plainfield Joint Sewage Works.

Mr. Downes stressed the desirability of consistent and frequent feeding of fresh solids to sludge digestors. He made a point of the importance of uniform heat application if gas production was to be steady and fairly uniform. The digestors shauld be kept as well filled as practicable and all units should be continuously and uniformly fed fresh solids. Lime, if required, should be fed continuously in small quantities to the solids being transferred to the digestors.

Mr. Downes referred to the early stages in heated digestion tanks when in 1925 at Plainfield a pit of 50 ft. square and 14 ft. deep had been covered with boards to form a floating cover. Later heat had been applied in February, 1926, by using pipe coils and hot water. The first concrete tank with floating cover had been placed in operation using hot water coils for heating on October 8, 1926. In the beginning coal had been used to get the sludge up to 74 deg. F. after which sludge gas had become available.

In drawing sludge from digestors, Mr. Downes warned against lowering the scum below the roof of the tanks to prevent sucking in air—that unless there was a gas holder in the system.

"The New Jersey Sewage Experimental Station Report" was delivered by **Dr. William Rudolfs,** Chief of that station.

Dr. Rudolfs reported on the **studies of various media used in sprinkling filters.** Stone, gravel and slag had been compared. The per cent of voids found had been for stone 49.8 per cent; gravel 44.5 per cent; slag 52.6 per cent. The solids had sloughed out of the stone and gravel more regularly than from

Paul Molitor, Sr., Superintendent, Madison-Chatham Sewage Treatment Works, With His Three Boys, Ed., Paul and Oliver—All Sewage Works Operators.

the slag. The relative accumulations of solids on the media for each cubic yard had been stone 148 lb.; gravel 145 lb.; slag 321 lb. The solids accumulated in the slag filter had been somewhat more than twice that found in the other filter and the volatile matter in the solids 2.5 times greater, viz.: 13.6 per cent.

Comparison of efficiency of different sizes of filter media (stone, gravel and slag) had disclosed that effluents from 2.5 to 3.5 in. materials had not been much different from those from 1.5 to 2.5 in. materials. The small size (¾ to 1¼ in.) had given considerably better effluents. There had been little or no disintegration of the slag noted and so far as fly breeding could be observed the counts of the larvae had indicated all media about the same in that respect.

Dr. Rudolfs said that **studies of the mechanism of the activated sludge process** was under way at a small plant, supplemented by laboratory scale studies. The question of nitrogen loss had been traced to that stage of the process during which nitrate production was taking place. Very little nitrogen had been expelled in the form of ammonia but rather as nitrogen. Some studies had been made wherein the activated sludge had been sterilized with chlorine. The result was a higher B. O. D. value of the liquid portion and a lower B. O. D. value for the sludge. The effects of varying solids content in the aeration tanks (15 to 75 per cent solids by volume) were being studied.

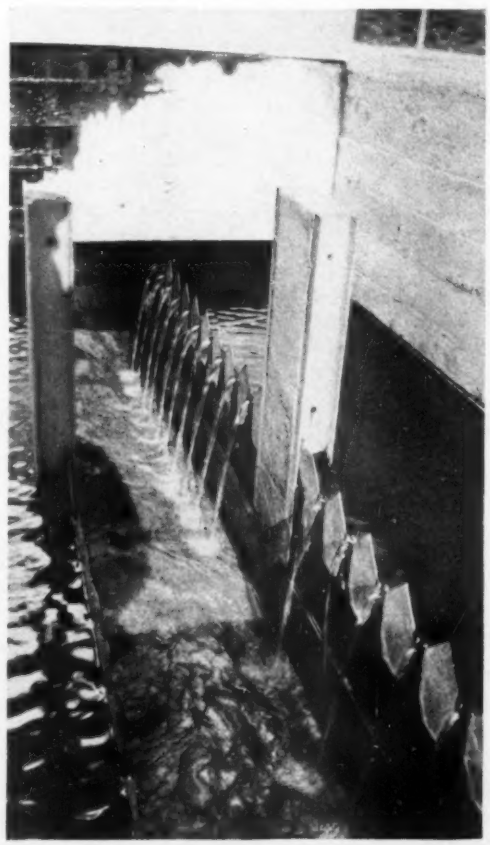
Reporting on **progress with thermophyllic digestion,** Dr. Rudolfs said that at 125 deg. F. the digestion time was but one-fifth that required at 74 deg. F. The heat losses had been two and one-half times as great at the higher temperature. Since the period for digestion is only 20 per cent as long, the heat loss will be more than taken care of by the increase in gas available. Forty-eight hours of digestion at 125 deg. F. reduces the volatile matter in the solids by 50 per cent and thereafter the rate slows down. Dr. Rudolfs said that in thermophyllic digestion the pH value rapidly rises to 8.0 and remains thereabouts. Eighty per cent of the total gas produced is evolved in the first 6 hours. Storage of gas in a gas holder will probably be required with high temperature digestion and to maintain a fairly uniform gas production solids must be fed the digestor at a fairly even and almost continuous rate. The new plant at Morristown, N. J., is equipped with one high temperature digestor in addition to the regular digestors and a gas holder. Dr. Rudolfs said that the quality of the gas was not different from that in ordinary digestion. He recommended stirring to release the rapidly forming gas and the return of supernatant to the crude sewage. There seemed to be some question as to the drainability of sludge from high temperature digestion in comparison with ordinary sludge and the effect of industrial wastes, he said, was not known.

Dr. Rudolfs said that investigations as to **effects of the solids concentration in fresh sludge on digestion tank performance** had indicated that 15 per cent solids was about the maximum that could be handled practically in digestion tanks. A much more dense digested sludge resulted if the solids content of the undigested sludge introduced was increased.

Dr. Rudolfs also reported on **aerobic digestion of sewage solids** and **the coke contact process.**

"The Work on the Hackensack Valley Sewerage Commission" was reviewed by **W. R. Smith,** Secretary and member of the Commission.

Mr. Smith said that the commission had been organized in January, 1931, after authorization by legislative act in 1930. The district covered included the counties of Hudson and Bergen (145 sq. mi.) and that the preliminary report with recommendations covering sewerage and sewage treatment, for the 57 municipalities involved, had already been made by



The Effluent From the Madison-Chatham Plant Speaks for Itself.

their engineers, Fuller & McClintock, and S. W. McClave.

Mr. Smith said that the report called for two separate systems—one in each county. There would be two treatment works of the activated sludge type with trunk sewers of sizes 30 to 102 in. designed for 30 years hence to handle storm and domestic sewage. Some pumping will be necessary. The treatment works would be alike except for size and were to be designed for 15 years hence. The population load divided itself into 392,000 (45 m.g.d.) on the proposed Northerly plant and 285,000 (34 m.g.d.) on the proposed Southerly plant. There would be preliminary sedimentation (1 hour); aeration (5.6 hours); final settling (3 hours) and sludge reaeration (4 hours).

The mixed sludges (crude and activated) would be digested in heated tanks (3 cu. ft. per capita capacity) supplemented by sludge storage tanks (2.1 cu. ft. per capita) and the digested sludge dried on sand beds having 0.6 sq. ft. per capita. This is to be the scheme provided that vacuum filtration and incineration have not proven practical by the time the plant is ready to be constructed.

Concerning estimated costs Mr. Smith said that the Fuller and McClintock report called for the following:

About 60 miles of sewers	$7,500,000
Treatment works (2 plants)	9,500,000
Land and rights of way	2,000,000
Total	$20,000,000

Operation of treatment plants about $22 to $25 per m.g.

All costs including amortization would amount to about $1,500,000 annually.

To finance the works and operations the division of cost between municipalities would be based on metered sewage contributed and that sewer service charges had been recommended as the most equitable method for financing and paying operating costs.

The proposed scheme, Mr. Smith said, would eliminate a large number of individual plants occupying valuable lands and entailing expensive operation and upkeep. The net result would be a reduction of costs and the nuisance of sewage disposal by the individual towns in the two densely populated counties served. It now remained to take the second step, which would comprise making the necessary detailed studies, selection of plant locations, etc.

"The Uses of Chlorine in Sewage Disposal" were covered by **L. H. Enslow,** Sanitary Engineer of the Chlorine Institute.

Mr. Enslow reviewed the progress made in chlorination of sewage in several aspects and variety of applications. The advantages of prechlorination of crude sewage were stressed and examples of greater economy and improved operating results resulting from prechlorination were cited. The results at the Millville, New Jersey, plant had indicated as much only recently. The advantages of using automatic chlorinators over and above manual controlled machines indicated the value and economy of the former in many instances—particularly where chlorine was purchased in 150 lb. cylinders at a price higher than the less costly chlorine available in one ton containers to the larger works.

As an example of what could be accomplished in the way of bathing beach protection by sewage chlorination along the North Jersey shore, Mr. Enslow reviewed the findings of the New Jersey State Department of Health before and after the sewage effluents had been chlorinated in that district. The net result had been more than 90 per cent reduction of intestinal bacteria in the bathing zones. Of great interest to him was the fact that this result had been accomplished when only about 75 per cent of the settled sewage from that district had been receiving chlorine treatment. Before chlorination the coli content of the bathing waters had averaged 50 to 60 per c.c. and since, but 2 to 4 per c.c. Such results could be explained by the fact that chlorination, even to a partial extent, will reduce the b. coli materially. Such an effect would be equivalent to providing greater dilution by the tides. Looking at it another way, it was equivalent, in terms of bacteria, to a 50 or 75 per cent reduction in sewage loading in the waters. That of course hinged on the fact that the fecal bacteria were reduced by those figures. Experience had indicated that it was usually possible to reduce the fecal bacteria by more than 50 per cent if the chlorine demand of the sewage was 50 per cent satisfied.

Mr. Enslow explained the newer development in sewage chlorination wherein the "lime-chlorine" process was being applied. Chloramines produced thereby had distinct advantages and the result had been more permanent effects and lowered costs.

In discussion **Leroy Forman,** of the New Jersey Department of Health confirmed the matter of b. coli reduction being greater than might be expected from partial chlorination of effluents but stressed the point that such practice was not thought satisfactory as routine operation and therefore the Department recommended that 100 per cent chlorination be practiced.

"Operation of the New Jersey License Law" was commented upon by **J. B. Baty,** Engineer of the State Department of Health.

Mr. Baty's talk had to do with the enforcement of the law in New Jersey which requires the operators of water and sewage works to secure a license after first satisfying the Department of Health of their fitness to operate such works. There are 375 sewage treatment plants and 115 water purification plants in New Jersey. During the period since the law had been enforced 481 licenses had been issued sewage plant operators and 231 had been issued water plant operators. He said that the department opposes supervision being given operation of plants by a licensed operator or engineer in order to evade the necessity of employing a licensed man as the regular full time operator. Court injunctions had been obtained where necessary to prevent the political expediency of appointing nonlicensed operators. **I. Riker** cited cases in which licensed engineers had been purposely retained by municipalities to supervise plants, in an attempt to evade the licensing law.

C. A. Emerson, presented a masterful analysis of the existing situation. He closed by suggesting that the Association give the Department of Health its whole-hearted support and help in getting the desired modification of the licensing law (now in committee) through the legislature and assist in its enforcement which would be to the benefit of operators, and the profession at large.

Important Resolutions Passed

A resolution drawn in January, 1932, by the Executive Committee and presented to the State Department of Health was read. It petitioned the Health Department to prosecute violators of the Operator License Law who displaced licensed operators with nonlicensed men; that part time service of licensed operators be condemned; that the action of some licensed engineers in abetting the practice of employing nonlicensed men be condemned and that the Association's resources and influence be given the Department of Health in enforcing the law. The resolutions were approved by unanimous vote on the floor of the meeting.

Sanitary Works in India

A visitor, B. R. Garudacher, Executive Engineer of the Health Department of the Province of Mysore, India, was requested to make a few remarks concerning India. Mr. Garudachar said that India had good filtration plants but little or nothing in the way of sewage treatment plants. There were several large irrigation dams and irrigation practice was good. Cast iron pipe of good quality is manufactured in Mysore and the province boasted of its own university and at Bangalore (the capital) there was also the Indian Institute of Science.

A Bit of History

Seventeen years ago the New Jersey Sewage Works Association was organized as the first Sewage Works Association in America with 15 charter members. C. G. Wigley, then Chief Engineer of the New Jersey State Board of health, was behind this movement. The first officers named were:

President—John R. Downes.

Vice-President—Paul Molitor, Sr.

Second Vice-President—I. Z. Collings.

Secretary-Treasurer—F. T. Parker.

Appearing on committees besides the above were the names Geo. W. Fuller, Rudolf Hering, Clyde Potts, C. G. Wigley, Alexander Vars, S. Fischer Miller, W. Dayton Fredericks, W. H. Frapwell, Harry Colmer, A. T. Rogers, David Clorin, and C. H. Powers.

From 15 charter members this Association has grown to its present membership totalling 355.

▼

Simple and Inexpensive Counter Device for Recording Sewage Flows

By RICHARD MESSER

Chief Engineer, Virginia State Board of Health

ONE of the most important items in connection with the operation of a sewage treatment plant is a record of the daily volumes of sewage treated. Many of the plans for the smaller cities, towns and at institutions have no provision for obtaining such measurements. Weirs are unsatisfactory unless equipped with recording devices and these are expensive.

At plants where the sewage passes through a siphon chamber, a very satisfactory and inexpensive recording counter can be used. The idea of using such a counter is not new—but the method of setting, as illustrated, may be helpful to others.

The illustration (Fig. 1) shows a simple device made by J. F. Noll, Superintendent of Public Works, Harrisonburg, Va. A simple Veeder-Root counter is set in a water meter case and the latter is bolted to the wall of the siphon chamber.

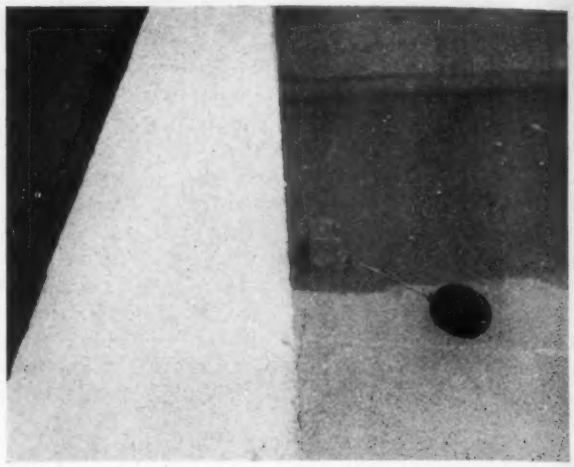


Fig. 1—Siphon Tank Discharge Counter Used at Sewage Plant, Harrisonburg, Va.

At Winchester, Va., the counter is set in a concrete block on top of the wall in the corner of the siphon chamber as shown in the accompanying sketch.

Veeder-Root, Inc., Hartford, Conn., furnishes counters of various types and sizes. A very satisfactory one

An old water meter case should be easily obtained without cost. Either a rubber or copper float, such as is used in a flush closet may be used.
shaft to turn top going. The price listed is $6.00.

A smaller counter may be obtained for about $2.25, described as follows: Small square-case rachet, counter

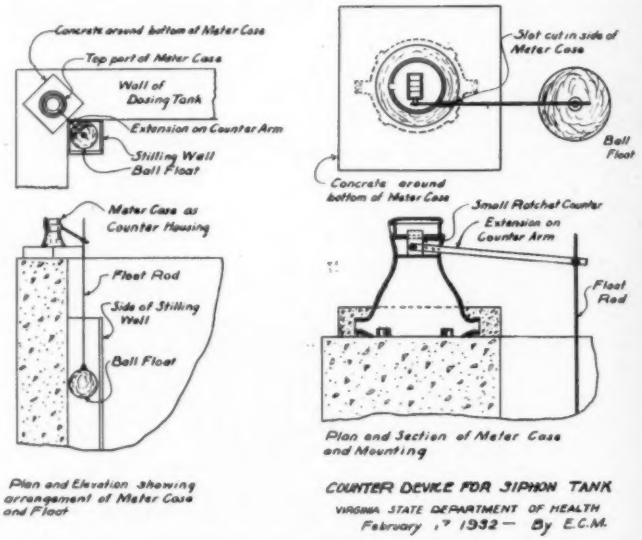

Concrete around bottom of Meter Case
Top part of Meter Case
Wall of Dosing Tank
Extension on Counter Arm
Stilling Well
Ball Float
Meter Case as Counter Housing
Float Rod
Side of Stilling Well
Ball Float
Plan and Elevation showing arrangement of Meter Case and Float
Slot cut in side of Meter Case
Ball Float
Concrete around bottom of Meter Case
Small Ratchet Counter
Extension on Counter Arm
Float Rod
Plan and Section of Meter Case and Mounting
COUNTER DEVICE FOR SIPHON TANK
VIRGINIA STATE DEPARTMENT OF HEALTH
February 1932 — By E.C.M.

Fig. 2—Plan, Elevation, Section and Details of Counter Device for Siphon Tank

for almost any siphon chamber is described as follows: Small reset rachet counter with five figure wheels, shaft on left (or right) side, knob reset, standard lever and with stops, flange case, five figure wheels, shaft on left (or right) side to turn top going and counter not to have return action spring.

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METERAGE AT COLUMBUS, O.—At the close of the year 1931 there were 59,997 active accounts—59,570 metered and 427 unmetered. The total number of services was 63,074, of which 59,627 were revenue producing.

SEWAGE TREATMENT PROJECT—CLEVELAND

By GEORGE B. GASCOIGNE
Consulting Sanitary Engineer,
Cleveland, O.

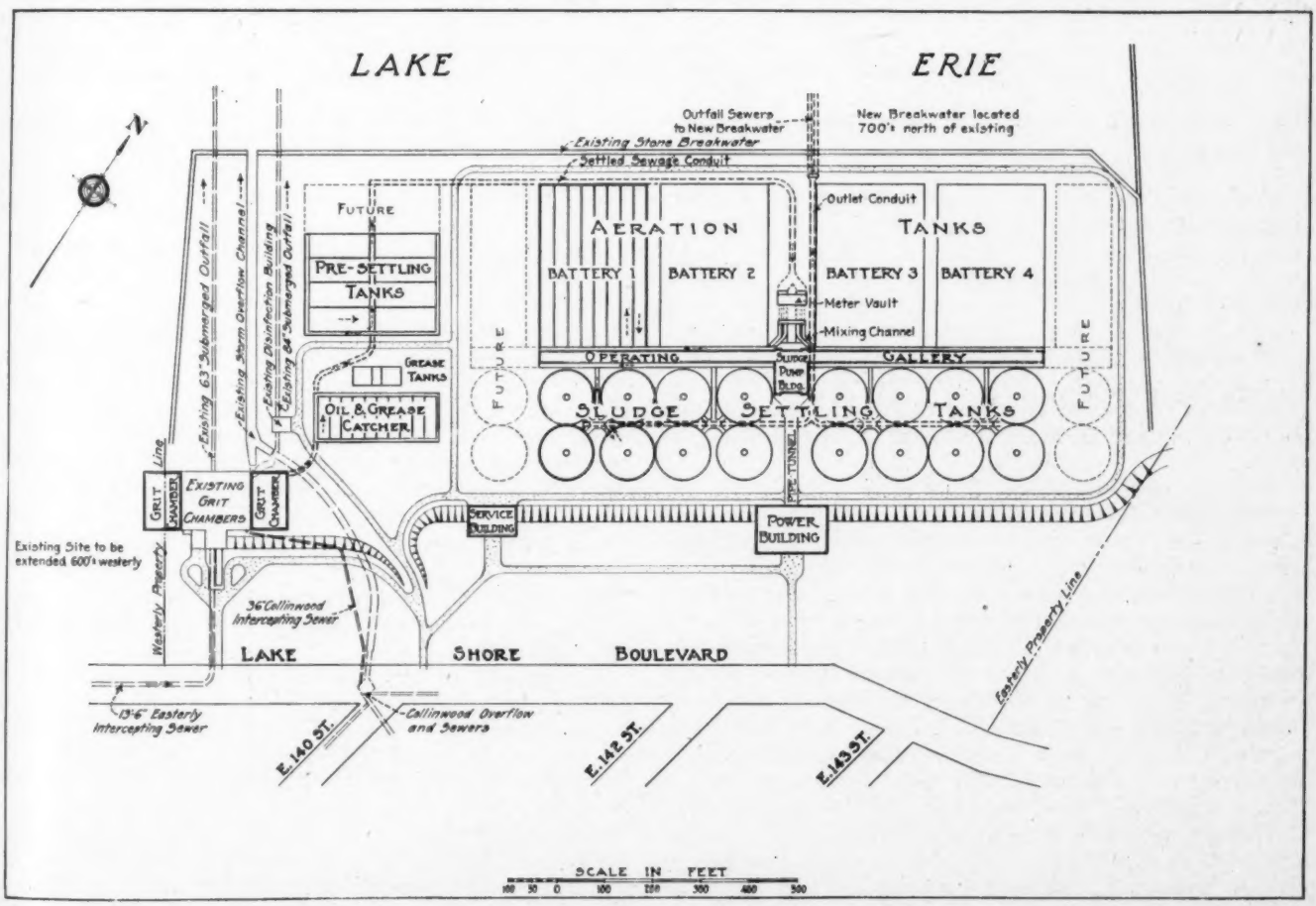
THE city of Cleveland is again actively engaged upon a construction program of sewage treatment works, or betterments to the partial plants which now exist. The expenditures involved by this program will amount to approximately $14,000,000 which have been authorized by a vote of the people. Bonds in the amount of $5,000,000 have been sold, and contracts in the amount of $3,250,000 have been certified.

George B. Gascoigne

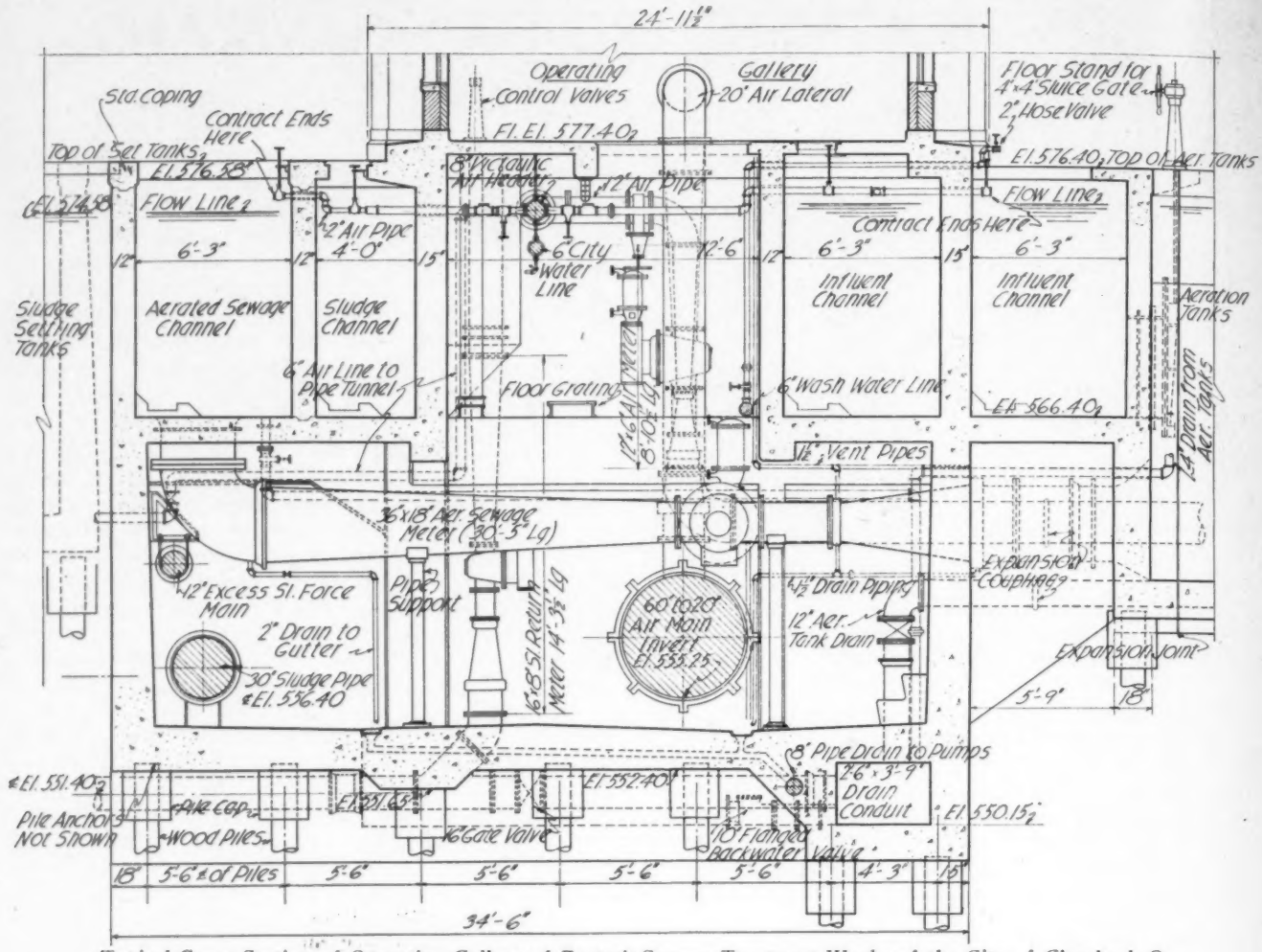
The work is being planned in such a manner that by the end of 1935, the sewage from the Easterly District will receive 92 per cent treatment, that from the Southerly District 85 per cent treatment, and at present that from the Westerly District 35 per cent treatment. These districts, although a part of the city of Cleveland, really represent service to metropolitan area. With the completion of these improvements, some $25,000,000 will have been spent for sewage treatment facilities with an average expenditure of practically $1,000,000 for each of the years the program has been in effect. Considering the intimate relationship between sewage disposal and water supply at Cleveland, this expenditure appears reasonable. Coupled with filtration of the water which has been in effect some years, the completion of the sewage treatment projects will provide modern sanitation facilities which will place Metropolitan Cleveland well abreast of other cities.

Reasons for Treatment

The treatment of sewage from the Easterly Sewerage District was based upon eliminating unsightly conditions and their attendant odors in the Easterly shore waters of the city, upon safeguarding the bathing beach waters, and upon removing a menace to the drinking water supply of the city. Furthermore, of the several sources of pollution entering these frontage waters, the facts indicated that the most outstanding was municipal sewage, and particularly that which is discharged at the Easterly site, where more than half of the sewage from 1,000,000 people is now concentrated. These conditions led to the conclusion that the installation of sewage treatment works for this area is a major step in a sound and proper sanitation program for the city, and that if the pollution load of these waters was to be substantially reduced, the proper procedure should be one of provid-



General Layout of Easterly Sewage Treatment Works of the City of Cleveland, O.



Typical Cross Section of Operating Gallery of Easterly Sewage Treatment Works of the City of Cleveland, O.

ing "complete treatment" for the sewage from this district.

Type of Plant Selected

A decision in favor of "complete treatment," and the importance and magnitude of the project, served to restrict consideration of treatment processes to works of the activated sludge type. The only alternative to the activated sludge process which might be considered available, was a plant of the tank-trickling filter type, such as is now used at the Southerly Works of the city. It was, however, clear that the lack of available area at the Easterly site, and the development of the surrounding property, are such as to prevent the use of trickling filters.

Sewage treatment by the activated sludge process, and with digestion of the solid matter, is entirely unobjectionable and unobtrusive. Considerable thought was given to the advantages of processing the sludge from the Easterly sewage, not at the site proper, but some 13 miles away, at the Southerly site, where sufficient land and isolation are available for such a procedure. At this time, and without any indication of material saving, it appeared unwise to place the city in the position of manufacturing each year, 30,000 tons of a low-grade fertilizer product for a highly competitive market, and involving all the difficulties of municipal operation. In this too, it should also be appreciated that the necessity for disposing of the sludge compels continuous processing, and irrespective of the ability of tne market to absorb the output. However, having in mind the possibilities of future developments in sludge processing, it was thought wise to concentrate the sewage solids of the Cleveland District at some central point, where advantage of such a procedure can be taken at a later date if deemed wise. For the immediate future, the sludge will be digested and dried.

Description of Easterly Plant

The sewage treatment works for the Easterly District will include bar gratings, grit chambers, pre-settling tanks, aeration tanks, sludge settling tanks and power house and administration building. These structures will be located at the Easterly site. Sludge as recovered in the primary and secondary processes will be pumped 13 miles to the Southerly Sewage Treatment Works where there will be provided sludge digestion tanks and covered sand drying beds. The dried sludge will be disposed of as fill unless used on nearby truck farms.

General Basis of Design

The present works will be capable of serving 770,000 people with a dry weather sewage flow of 123 M.G.D. These conditions represent estimated needs of the year 1945. The plant will be laid out to serve ultimately 1,000,000 people.

The sewage to be treated is estimated to have a suspended matter content of 200 p.p.m., total nitrogen of 20 p.p.m., B.O.D. value of 150 p.p.m., and average iron content of 20 p.p.m. The grease catchers and pre-settling tanks of the proposed works will be able to treat all flows of sewage and storm water up to two and one-half times the average dry weather flow. Aeration and sludge settling tanks will be capable of treating flows to one and one-half times the average dry weather flow and sludge treatment devices will be planned accordingly.

At the present time, such basic features, as bar grat-

ings, grit chambers, grease and oil catchers, and presettling tanks, have been developed only in a general manner.

The aeration and sludge settling tanks will be grouped into four major batteries, as shown upon the accompanying layout plan. These batteries, which can be operated jointly or independently, will consist each of four aeration tanks and four sludge settling tanks. The aeration tanks will be built in two passes, each 27 ft. wide and having a water depth of 15 ft. The length of horizontal travel of the sewage will be 670 ft. Aeration and agitation of the sewage will be provided by air diffused through porous plates with aluminum containers, so placed as to induce spiral flow of the sewage and to prevent short-circuiting. The aeration period will be five hours, based upon 125 per cent of the rated capacity, with a sludge return of 25 per cent. The air for aeration will be supplied from electric driven air compressors of such capacity as to provide not less than 1 cu. ft. of air per gallon of sewage treated, excluding aeration for channels and grease removal. Proper provisions will be made for conditioning and distributing the air.

The sludge settling tanks will be circular tanks, 112 ft. in diameter and with a side water depth of 12 ft. They will be of the central feed, peripheral withdrawal type, and will be equipped with revolving sludge removal mechanism manufactured by the Dorr Company. These tanks will provide about two and one-half hours detention for the dry weather sewage flow increased by 25 per cent for returned sludge, and they offer superficial water area equivalent to a settling rate of about 1,075 gallons per square foot per day. Upon a gross area basis, this figure reduces to 975. Each battery of four settling tanks will be provided with a distribution chamber which will permit of equalizing the flow to each tank and also of cutting any tank out of service.

Located between the aeration and sludge settling tanks will be an operating gallery with some unusual features, particularly for a large installation. This gallery will be covered with a building to house the measuring equipment and will permit of regulation or control of the plant features, with a minimum of inconvenience.

A sludge force main will be provided to connect the Easterly Works with the Southerly site, pumps being provided for handling the deposited material or sludge. At present, it is impossible to describe, except in a very general manner, the major features pertaining to the sludge force main, which will connect the Easterly and Southerly sites. The same is true concerning features pertaining to the sludge digestion tanks and drying beds. The power building and service building in their final design are likewise matters for future decision.

Cost of Work

In estimating the cost of the Easterly plant it was assumed that the work would be done by contract let under competitive bidding, and upon a unit price basis. The estimates are at a level about 80 per cent in advance of the 1913 level. Such a scale was deemed applicable for the construction of large works, over the several years that will be required for the project, with an allowance of 10 per cent to cover the cost of contingencies, engineering, printing and legal expenses. The Easterly project has been estimated to cost $12,000,000 and the annual cost of properly and efficiently operating the recommended works has been estimated at $600,000 as of the year 1940. This operating estimate is based upon a rate of $0.008 per KWH for pumpage of sewage and sludge, and $0.007 per KWH for compressor power.

Program of Construction

A progressive program of construction is being followed with a corresponding budget of expenditures, which designate the requirements year by year until the entire plant is completed and ready to be placed in continuous operating service. Naturally, this has the effect of dividing the project into major contracts, and it has been decided to follow a plan which provides for the earliest completion of the entire work, and upon the basis of obtaining good work without undue cost. This means proceeding first with contracts for breakwater construction which protects the site, and with a major contract for the aeration and sludge settling tanks, an item of the project which actually controls the time of completion. In the Fall of 1931, and in accordance with the construction program outlined, bids upon these contracts were received, and the work has been awarded to the American Construction Company of Cleveland.

Westerly Sewage Works

Another major step in providing adequate sewage treatment facilities for Metropolitan Cleveland, is one of betterments to and enlargements of the Westerly Plant, which was placed in operation in 1921, and designed to serve conditions approximately as of 1930. Investigations of the existing conditions have been going on, and at present pertain in particular to the provision of additional capacity, elimination of odors from deposited oil and grease, and disposal of the sludge other than by discharging it through the existing outfall sewer into the lake some one-half mile off shore. Present plans point in the direction of providing additional grit chambers, oil and grease catchers, some digestion tanks, and incineration facilities during the coming spring, in order to have them available for operation by this coming summer.

The Cleveland work is being carried on under the general direction of William J. Kennedy, Director of Public Service, with George B. Sowers, Commissioner of Engineering and Construction. Robert Hoffmann is Consulting Engineer, with the writer and his associates in immediate charge of the design, supervision of construction, and operation. Upon particular problems, Charles H. Hurd of Indianapolis, Ind., and D. W. Townsend of Milwaukee, Wis., have been associated with the writer's organization.

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Sewers and "Suds"

We are indebted to one of our readers who had read the editorial comments on "New Use for Sewers" in Water Works and Sewerage for January. He reports that just recently there had been discovered a "*Newer*" use for sewers, to-wit:

"In Lancaster, Pa., last week a workman's pick penetrated a new sewer. A geyser of amber colored liquid and foam spouted up. It proved to be nothing less than beer—and good beer at that. Inspection showed some one had laid a pipe line within certain sewers recently completed under the present improvement program. According to the local papers the line had more than one branch and was several hundred feet long. A part of it was apparently composed of fire hose. Further investigation will probably reveal a brewery at one end and a long line of thirsty customers at the other."

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Central State Section Will Meet at Erie, Pa.—The Central States Section of the American Water Works Association have set Sept. 22nd and 23rd as the dates of its 34th annual convention to be held at the Hotel Lawrence, Erie, Pa. B. J. Lechner, Erie, Pa., is secretary-treasurer.

FILTRATION PLANTS

A Section Dealing with Their Design, Construction and Operation

Conducted by JOHN R. BAYLIS, Associate Editor
Physical Chemist, Bureau of Engineering, Chicago, Ill.

KEEPING RAPID SAND FILTER BEDS IN GOOD CONDITION

IT is not the purpose of this article to define how filter beds may be designed which will remain free from trouble, but to offer a few suggestions to the operators as to how they may keep their filters operating efficiently even though they have a difficult water to handle.

The Character of the Water Is the Cause of Most Filter Bed Trouble.—Two filter plants may be constructed exactly alike, have sand of the same size and from the same source, and be operated in almost exactly the same manner, yet the filter beds in one remain nearly free from trouble and the beds in the other plant clog badly. The treatment of the two waters may be so nearly the same it is evident that the cause of the trouble is the water. In most instances it is not possible to definitely fix the blame for clogging in filter beds on the water, and largely for this reason hard places in the beds are frequently attributed to improper washing or to a poorly designed underdrainage system. It should be stated that improper washing and poorly designed underdrains will cause the beds to clog when they might not otherwise do so, but it is believed that most clogging is due to other causes.

For waters which have a high clogging tendency it is evident that the design of the underdrains should be the best and that the beds should be washed with care and at a rate as high as is practical without disturbing the gravel layer and without causing the loss of any of the sand. The exercise of care in washing the filters might help considerably in keeping the beds in fair condition with waters that have a tendency to cause them to clog. It is not possible, however, to keep the beds in some plants in good condition without doing something to aid the regular washing; that is, without producing more agitation of the sand than is accomplished by the usual wash.

The type of water which produces the greatest clogging is water which causes a gelatinous coating to form around the sand grains. Certain waters fairly high in organic content cause the filter beds to clog considerably. Practically all waters containing manganese cause clogging. Manganese, combined with a fairly high organic content, produces a condition in which it is almost impossible to keep the beds in good condition. The extent to which clogging may take place under such conditions is illustrated by the photograph in Figure 1. There is nothing within reasonable cost the operators of large or fairly large plants may do to keep the filter beds in good condition under such circumstances. One man for each 5 million gallon capacity of the plant constantly at work digging out the clogged places could not keep the beds in good condition. The operators of plants less than one million gallon capacity might, by giving a great deal of attention to the beds, keep the clogging at a minimum, but where the duties of the operators keep them fairly

Fig. 1.—Badly Clogged Filter Bed

busy it may not be possible even in a very small plant to maintain the beds in perfect condition.

Fairly fine sand is a contributing cause of filter bed clogging in some plants. Use of the word "clog" in this article means the formation of hard spots in the sand beds which are not broken up in washing. Where there is considerable clogging in a filter bed and the 10 per cent size of the sand, commonly called the effective size, is less than 0.45 mm. diameter, coarse sand should be tried. If the use of coarser sand does prevent the trouble it should lessen it. This may mean under some conditions the filters with the coarse sand will have to be washed at a loss of head less than 8 ft. There should be no objection to washing at a lesser loss of head if there is some means other than loss of head to tell when the filter should be washed. By equipping each filter with a floc detector, which has been previously described[1], there should be no difficulty in preventing flocculated matter passing the beds during periods when the flocculation is weak.

Breaking Up Clogged Places in Sand Beds.—Clogged

[1]Baylis, John R. Watch for Flocculated Matter Passing the Filter Beds. WATER WORKS AND SEWERAGE, 77: 417-20, December, 1930.

masses composed principally of sand tend to settle to the bottom of the sand bed in rapid sand filters. When the proportion of mud or coagulated material to that of the sand is great in a mud ball it will stay at or near the surface of the sand. The proportion of sand in mud balls varies greatly, consequently some of the mud balls will sink to the gravel surface, some will remain distributed throughout the sand bed, and some will remain at the surface. It is common to see mud balls on the sand surface ½ to 1 in. in diameter, and sometimes very much larger.

Contrary to the belief of many, the water does not flow upward at a uniform velocity throughout the filter when it is being washed. If it were possible to see into a sand bed partially suspended during washing it would be noted that the water and sand are rushing upward in places at a fairly high rate and downward at other places. In other words, the filter bed is composed of a number of boils while it is being washed. Where the water and sand flows downward between the boils are the points where the mud balls or clogged masses of sand are deposited on the gravel surface.

Clogged or hard places almost invariably rest upon the gravel. If there is any exception to this statement it is where the clogged mass sticks to the sidewall of the filter. Even along the sidewalls the clogged places almost invariably rest upon the gravel. Any force that will completely break up a clogged or hard place must reach the top of the gravel. It may be possible to break the upper portion of hard places with a hose, especially where the clogging extends to or nearly to the sand surface, but it usually is only a very short time before it builds up again. The main portion of a hard spot cannot be reached with a hose.

Hard Spots Should Be Dug Out.—There is only one satisfactory way of breaking up clogged places in filter beds and that is to dig them out. Drain the water from the filter and dig out the sand from an area considerably larger than the clogged place. The sand need not be removed from the filter, but shoveled back on top of the other sand. The most compact part of the clogged place will be at the gravel layer. If it is a fairly large clogged place the weight will force it down to where the bottom is one to several inches below the top of the surrounding gravel. Practically every hard spot will be buried slightly within the gravel.

A rake or trowel may be used for removing the clogged material from the gravel. If the clogged mass has embedded itself over an inch below the gravel surface the hole should be filled with gravel before the sand bed is leveled. Sometimes it is possible to merely level up the gravel by raking the surrounding gravel into the depression, and in other cases where the hard place extends deep enough to reach larger size gravel than that of the top layer the hole should be filled so that it will be graded with gravel the same as is in the undisturbed portion of the gravel. This may require removing some of the gravel and replacing it with properly screened material. Dumping fine gravel into such holes without regard to the size and depth of the hole may be producing ideal conditions for another clogged place to start forming.

Where there is considerable clogging in a filter bed it is best to remove all the sand from the filter. The hard places should then be dug out of the gravel, and the gravel leveled up properly before replacing the sand. Under such conditions it is usually best to remove all the material from the bed, rescreen the gravel and place it back in the bed in the original order. By removing the gravel, the underdrains can be examined and any clogged holes opened. Sometimes the beginning of the trouble is a partial stoppage of the holes in the underdrains.

Most Clogging Is Usually Along the Sidewalls.—The place where most sand clogging starts is along the sidewalls of the filters. In many plants this is the only point where the clogging is serious. Designers of filtration plants have tried various modifications of the filter beds to avoid clogging along the sidewalls. At one time filter specifications frequently called for a roughening of the sidewalls where they came in contact with the sand. This probably is the worst thing that could be done. Additional openings have been placed in the underdrains along the sidewalls in some plants with the hope that the greater volume of water will prevent sidewall clogging. In one or two instances the sidewalls have been sloped inward with the hope of avoiding cracks which usually open along the sidewalls and are the forerunners of clogged places. It should be evident to every one that these provisions will not prevent clogging along the sidewalls.

Without removing the sand from the filter, it is the frequent custom to dig up the sand along the sidewalls and throw it out to the center of the bed. This is a very good plan if repeated with sufficient frequency to prevent clogging. The one doing the digging should remove the sand to the level of the gravel and should be very careful not to disturb the gravel. It is essential to remove any clogged masses that may be resting upon the gravel. Some waters form clogged places so rapidly at times it may be necessary to dig up the sand along the sidewalls every week or ten days to prevent clogged places forming. Usually when the tendency to clog is great, clogged places will form throughout the filter bed. It might be possible also to dig out clogged places in the center of the beds without removing the sand from the filters, though this is not practiced as much as digging along the sidewalls.

Other Methods of Removing Clogged Places.—The operators in a few filtration plants attempt to prevent clogging by means other than digging out the clogged places. Sometimes a hose is used. The water is drained from the filter and a hose with a ½ to ¾ in. nozzle is used. The entire surface of the bed may be gone over, or only that portion where the clogging is taking place. This procedure probably will break up most of the mud balls on the surface and within the sand near the surface. Where the hard spots extend to the surface of the sand the top of these spots may be broken up. Part of the gelatinous coating around the sand grains may be knocked off with the hose and this lessens the tendency of the sand to form clogged masses. With the amount of water and labor required there is doubt about this being an efficient method of preventing clogging though it may be effective in some plants. If used, it should be to prevent clogged places forming by keeping the sand clean, for it does not reach deep enough to break up clogged places resting upon the gravel.

A few operators use a pipe fastened to the end of a hose, the pipe being of such size and length as to be easily handled from the top of the filter. The end which is forced into the sand bed is capped and small holes are drilled near the end so as to throw jets of water in all directions. The water is turned on and the end of the pipe is pushed down beneath the sand at the clogged places. The jets break up or partially break up the clogged places. Such an arrangement probably is only partially successful, for it cannot reach and break up all the clogged places at the gravel surface without disturbing the gravel to the extent that more

serious clogging may follow and the sand may find its way through the gravel. This procedure does break up many of the clogged places to the extent that at least a short time is required for the places to again form.

Use is sometimes made of a flat piece of sheet iron about 6 in. by 12 in. fastened to the end of a ½ in. pipe to form a scraper for breaking up clogged places in the beds when the filter is being washed. It is easy to locate the hard places when the sand is partially suspended by moving the scraper over the bottom of the filter just above the gravel. When a hard place is located the operator sometimes presses down to crush it, but the best procedure is to get the end of the plate underneath the hard spot at the gravel surface and pull it upwards. When it is dislodged from its original resting place pressing down on it lightly will

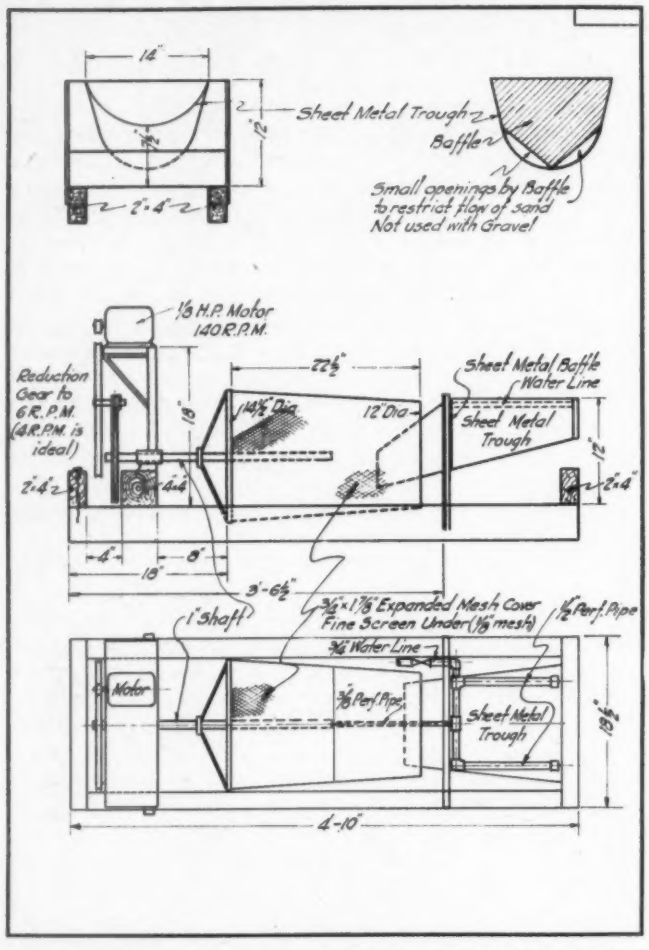


Fig. 2.—Sand Screens at Water Works of East Chicago, Ind.

crush it. It is very difficult to crush hard spots when they rest in their original position and there is danger of burying them deeper without crushing the portion projecting into the gravel. Where there are only a few small filter beds to operate it is not difficult for the operators to keep them in very good condition with a scraper, but it is evident that such a procedure is not practical for a large plant.

Some operators use a long-tooth rake for breaking up the clogged places when the filters are being washed. Such a tool is light, easy to handle, and is very effective when used properly. There is less danger of disturbing the gravel with a long-tooth rake than most anything that may be used. It is believed possible to pull the hard places out of the gravel without disturbing the gravel. A long-tooth rake with a long light wooden handle so that the gravel layer may be reached from the top of the filter is more likely to be used by the filter operators than something heavier.

Flentje and Cramer[2] show a photograph of a man standing nearly submerged in a filter bed while it is being washed and state that it is the only practical method of breaking up hard spots and mud balls. Presumably the man walks about over the gravel, feels for hard places, and breaks them up probably by crushing with his feet. There is no doubt about this being an effective way of breaking up hard places, but it is not believed that there would be many applicants for such a position when the water is cold.

The sand washing machine shown in Fig. 2 is a drawing prepared by Pearse, Greeley and Hansen of a machine used at East Chicago, Ind., for washing and screening the sand. The machine sets upon boards resting on the wash water troughs. The sand is shoveled into the hopper by a laborer and the jets of water flush it on to the screen. The sand falls back into the filter and the mud balls, etc., which are not broken up fall out the motor end of the screen on to a pan or into the wash water trough. The ease with which the machine may be moved about in the filter, and from filter to filter makes it a very serviceable machine for a small plant.

Use of an Alkali.—Caustic soda has been used to a limited extent for removing the coating from sand grains. In some instances fairly good results have been reported. The method of using an alkali at Detroit, as described by Hulbert and Herring[3], is a very good example of how caustic soda may be used. The filters were drained dry, and 400 lb. of lye flakes per 500 sq. ft. of filter surface were spread over the surface. The wash water was turned on slowly to raise the water level about 8 in. above the sand. The water was stirred with a paddle to mix the lye thoroughly. This produces approximately a 2 per cent solution of caustic soda above the sand. The water is then drawn down about 4 in. so as to bring the sodium hydroxide solution more directly in contact with the sand. After standing about 24 hours the water is again lowered to where the sand is just submerged. It is held at this level for one to two days, and the alkali is then washed out. A ½ in. stream from a fire hose is then turned on and the entire filter gone over. Part of the coating around the sand grains is dissolved by the alkali and the remainder so loosened that the hose will knock most of it off. The hose is effective to a depth of 8 to 12 in. After using the hose the filter is again washed in the usual manner and is ready to be put into service.

The Surface Wash.—Several times the writer has mentioned the use of a surface wash for keeping filter beds in good condition. This is a system of piping located just above the sand surface with holes about 3/16 in. in diameter arranged so as to project jets of water about 30 degrees to the horizontal. At least one jet to each 2 sq. ft. of filter surface should be provided. A very good surface washing system is one that throws about 3 to 4 gal. of water per square foot per minute. The surface wash is simultaneous with the regular wash, and does not take its place. With its use less water may be required in the regular wash. The surface wash should not be considered a means of breaking up hard spots in filter beds, force not extending to the gravel.

[2]Flentje, M. J., and Cramer, C. Building Efficiency Into an Old Purification Plant. Water Works Engineering, 83: 421-2, 450, 453-4, March 26, 1930.

[3]Hulbert, R., and Herring, F. W. Studies on the Washing of Rapid Filters. Jl. Am. Water Works Assoc., 21: 1445-1513, November, 1929.

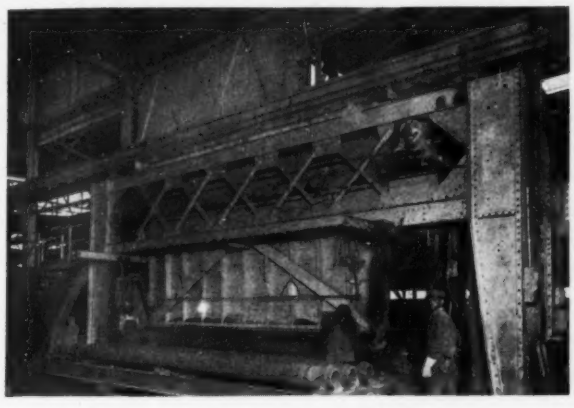
HORIZONTAL CASTING OF PIPE BY THE GREEN SAND MULTIPLE GATE METHOD

By PORTER W. ALLEN

Eastern Manager Sales,
McWane Cast Iron Pipe Co.

SO far as principles are concerned, there is nothing new about the McWane Cast Iron Pipe Company method of casting pipe horizontally. The first cast iron pipe ever made—part of which is still in service at various points, notably at Versailles, in France, laid in 1685—was so cast. The difference is in lengths and methods. And the far cry from these one-meter lengths in the 17th century to 16-ft. lengths of McWane pipe in the 20th is the theme of this paper.

The primary object was to produce a better pipe. If the iron were stronger, the weight and cost of the pipe could be reduced. But this must be accomplished without sacrifice of length, uniformity, or flexibility. Back of the decision to accomplish this end by using the time-



Mechanical Core Machine. Green Sand Falling in a Narrow Stream from a Hopper on to a Rapidly Revolving Barrel Forms a Straight Smooth Core. The Cores Are Loaded on a Special Car

tried principle of horizontal casting in green sand was the established fact that where two pipe are cast from iron of the same composition, one in a green sand and one in a dry sand mould, the pipe cast in the green sand would show a denser structure and a correspondingly greater strength. This point will be elaborated later on in this discussion.

In the earlier days of pipe-making—despite the fact that the longest-lived pipe known today was so cast—horizontal casting had presented difficulties in handling the cores, in pouring, and in the moulding that baffled the old-time pipe makers. It is with the overcoming of these difficulties that we are concerned; how modern inventiveness and modern methods surmounted these obstacles.

Passing rapidly over earlier developments in the McWane foundries, when only hand methods embodying the time-tried principles of horizontal casting were employed in the main, we come to the ultimate word in such methods of pipe casting as now are in operation in the mechanical cast iron pipe-making units in the McWane foundries.

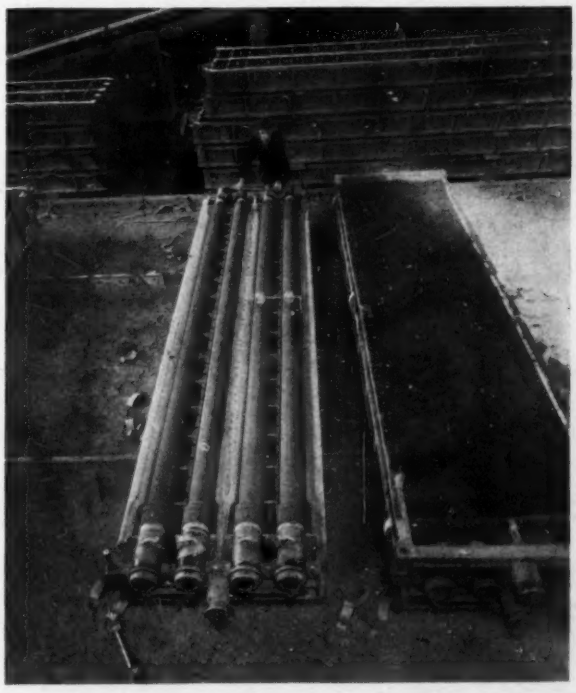
The latest method simply substitutes mechanical equipment for hand labor, the best features of other types of foundries are adapted therein to pipe foundries. It also embodies features of continuous operation and flexibility of output not previously known or possible in the manufacture of cast iron pipe.

The layout of the new foundries is interesting mainly in the way it permits this continuous operation, with production scheduled as in a rolling-mill. Instead of a certain number of moulds being prepared and the molten iron subsequently poured into them, ramming, core-making, core-setting, pouring, shaking-out, core-bar pulling—and the return of the flasks, sand, and corebars for immediate reuse—are simultaneous operations.

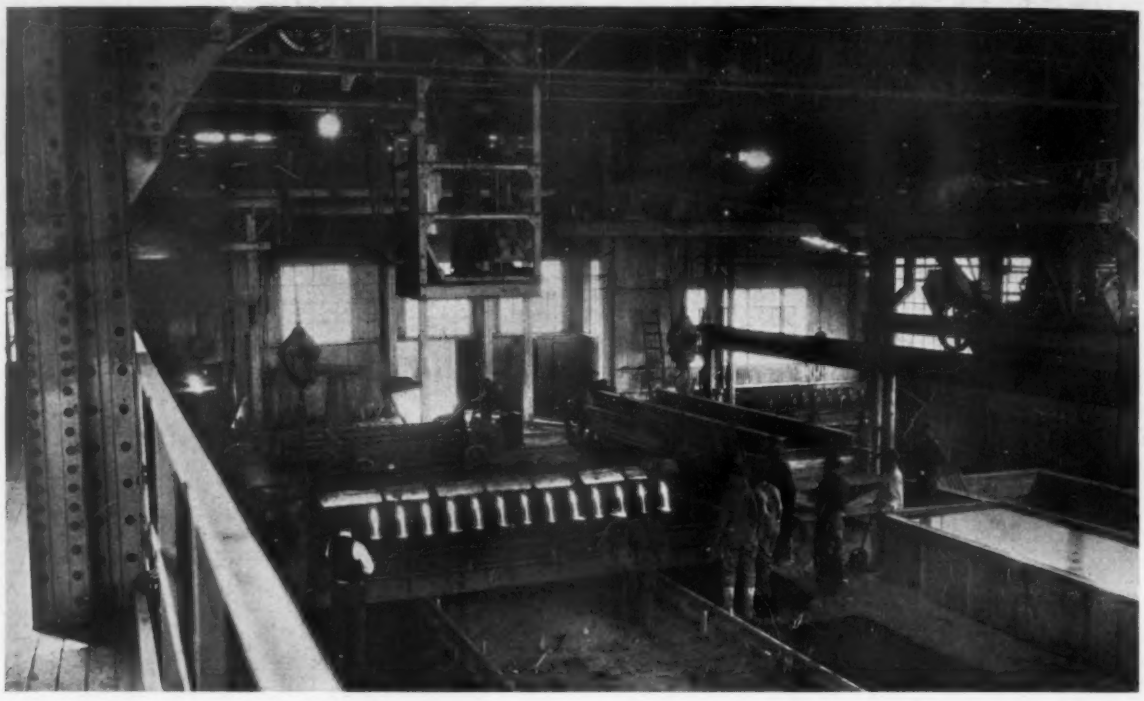
Perhaps the most outstanding feature of the new McWane process is that, instead of a certain division of classes and sizes of pipe-making equipment arbitrarily fixing the relative output of each different size pipe per day, the entire mechanical unit runs on a given size. Thus orders—and not the proportion of plant equipment devoted to each size pipe—determine the production.

Another feature of the McWane process is that a different mix of iron is used for each size of pipe. Iron which will make the best 12-in. pipe does not necessarily make the best 2-in. By varying the "mix" in the cupolas, the McWane foundries have standardized on the proper mix for each size of pipe to be made, bringing about a new uniformity in the pipe with respect to texture and quality.

A step-by-step description of just how McWane pipe is produced is illuminating. In the first place, the moulding sand is bought, blended, inspected, handled, and re-handled with minute care. It becomes a known



Pipe Molds. Open and Assembled Molds Showing Arrangement of Gates and Runners



Iron Ladle. Iron Is Poured Simultaneously Into the Entire Length of the Pipe Through 14 Gates from a Special Multiple Lip Ladle

and fixed quantity. On its return by mechanical conveyors from the mould shake-out machine, this sand is re-conditioned and returned by conveyors to the bins above the jolt ramming machines for re-use.

When a pipe mould is placed on the jolt rammer, a mechanical jolt-ramming at a speed of 150 jolts per minute follows, and the ramming is finished off then with pneumatic rammers. The same process is used for both copes and drags.

An overhead crane then moves the flasks to where the cores are to be set in the moulds horizontally. Every move is in a fixed sequence and is that much nearer the cupolas each time. In the McWane process the moulds go to the iron—not the iron to the moulds; a valuable part of the rigid heat-control which also is responsible for the quality of McWane pipe.

In setting the cores, which is the next operation, gauge-readings determine to a nicety the exactness of the core-setting. By a patented method of anchoring, the cores are so held at each end that there is no movement or sag as the molten iron enters the moulds.

The importance of the core to McWane pipe cannot be minimized. Not only is the outer surface of the pipe—its "skin" wherein its real strength and flexibility lie—in contact with the green sand of the mould; but also its *inner surface* is in contact with the strengthening green sand of the core. Thus is the grain of the iron on both the outer *and* inner surfaces of McWane pipe closed and its structures doubly strengthened.

The bars on which the cores are made are perforated and tubular. After each use they are cleaned, tested for straightness, and delivered alongside the core-making machines.

Core-making means revolving the core-bars in a core-making machine. A thin stream of sand falls on the bar with sufficient force to pack the sand to the required density, while a long "strike," adjusted accurately to the proper diameter for the core, removes surplus sand and leaves a smooth, straight core that is accurate to within a plus or minus tolerance of a few thousandths of an inch.

Following the setting of these cores in the flasks, the flask is closed, and made ready for the iron. Again a crane picks it up, and swings it forward to the pouring floor, near the cupolas.

In pouring McWane pipe, a long, multiple-lip ladle is used to bring the iron from the cupolas to the moulds. Each of these ladles is equipped with a number of self-skimming spouts. Two pipe are poured at once. At the tilting of the ladle the molten iron runs through the numerous spouts on its side into the pouring basin which has been formed in the sand of the mould. It flows thence through self-skimming "gates," closely and equally spaced, into the body of the pipe.

With such distribution of gates, the molten metal fills the mould in a minimum period of time, and at a uniform temperature throughout the entire length of the pipe. The gating method used obviates undue strain on any part of the mould or core. The sand at one point is not exposed for any length of time to the erosive action of flowing iron; and the mould is filled so rapidly that imperfections are automatically guarded against. As an additional insurance of good pipe, the self-skimming features of the ladle spouts and mould gates just mentioned, prevent any impurities entering the pipe.

After cooling sufficiently, each mould is taken apart, overhead cranes again serve in the operation, and the pipe is removed from the sand. The mould then goes to the shake-out machines, the sand is returned to the sand re-conditioning department, and the whole process starts over again without pause.

The new-made pipe are moved to a tilting device equipped with vibrators that go into action as its platform tilts. By the time the pipe has attained an elevation of 45 degrees almost all the sand has escaped from it, and the core barrel follows.

Next, the pipe reaches a specially-designed scrubbing machine, where it is rapidly revolved in contact with a great number of hard iron scrapers, mounted individually on a long horizontal bar. Tumbling barrels are used for the smaller diameter pipe in lengths of 12 ft. or less.

After the cleaning process, each pipe is submitted to a hydrostatic test of 500 lb. per sq. in., as well as to a hammer test at the same time. In addition, each pipe is weighed, given visual inspections, and every bell and every spigot must pass a gauge-test for accuracy of dimensions. Summed up, this means that every length of McWane pipe must pass six inspections before it is approved as a finished product.

Another notable feature of the McWane process is that the hydrostatic test is given before the pipe is given the conventional pitch coating. The reason for this being that tiny imperfections can be detected in an uncoated pipe that might cause a pipe-user trouble later if allowed to be covered up with a coating of pitch before testing.

Before leaving the subject of horizontal casting it is desirable to call attention to the greater flexibility which the process permits in the design of the pipe. By the horizontal method a bead can be cast on pipe of the new modern weights and thicknesses, and with special moulds, tapping bosses for large size taps can be cast on the pipe and results in the saving of a fitting.

McWane pipe possesses all of the qualities inherent to a purely sand-cast pipe—from a standpoint of handling, cutting, and tapping—with features of the more modern pipe, such as straightness, high strength with lighter weight, and a uniformity of wall-thickness.

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The Allen Hazen Water Tower

The water tower completed a short time ago at Des Moines, Iowa, was named the Allen Hazen Tower by the Board of Water Works Trustees as a testimonial of the service rendered by the late Mr. Allen Hazen during his activity in the capacity of Consulting Engineer to the Des Moines Water Works Department.

This architecturally beautiful structure was designed, and its construction supervised, by Mr. Hazen* and his

Allen Hazen Water Tower, Des Moines, Ia.

partner Mr. Chester M. Everett of New York City.

It holds 2,000,000 gallons of water, is 100 ft. high above foundations, has a diameter of 110 ft. and depth of 19 ft. There are fifteen columns supporting the tank, each having a diameter of 6 ft. 2 in. and a height of 50 ft.

The structure is of concrete up to the base of the steel tank. The tank has a flat bottom and is of the ordinary oil tank type of construction. By special butt jointing and countersunk riveting the outside is left perfectly smooth.

The tank rests on a concrete deck supported by the outer columns and the center concrete cylinder which is 50 ft. in diameter. The entire structure is carried on a foundation of Raymond concrete piles varying in length from 25 to 35 ft.

The structure is a fitting memorial to an engineer-chemist who contributed so much toward developing American Water Works Practice.

*Ed. Note:—Mr. Hazen died July 26, 1930, before completion of the water tower.

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West Shore Water Producers Association

A meeting of this association was held March 9 at the Elks' Club, Milwaukee, Wis. J. P. Schwada, City Engineer of Milwaukee, opened the meeting with a welcome to the organization.

Ed Tanghe described **"Milwaukee's Experiments With Elevated Storage."** He stated that the installation of a new 60 m.g.d. turbine in the Riverside Station next summer would take up the last available space in existing stations for new pumps, and that the needs for further capacity in the near future would require a new pumping station, or some other alternative. In 1930 a 1½ million gallon elevated tank on the south side of the city relieved acute pressure deficiency during peak hours. In 1931 another similar tank was built on the west side in a district which was suffering from the same trouble. This system of storing water in districts where pressure troubles exist, due to topography or other reasons, during off-peak hours, and then releasing it to the system during the period of maximum demand, has been so successful in the districts where applied that further tanks will probably be built to forestall the construction of a new pump station. Another proposed improvement is the construction of a combined booster station and storage reservoir. It has been estimated that this plan together with other elevated tanks planned, would supply the needs of the city for ten to twenty years at an investment of only $500,000.

H. P. Bohmann, Superintendent of the Milwaukee Water Department described **"The Milwaukee Water System."** The system today represents a capital investment of $26,000,000. The success attained by the department was attributed by Mr. Bohmann to three factors—good engineering, freedom of department from political interference, and universal metering. The department is not taxed by the city, but returns $300,000 to the general fund each year in lieu of taxes.

There was a general discussion on Mr. Bohmann's remarks.

Herbert Schmitt, of the Milwaukee Water Department, outlined the **"Progress Made by the City Toward Filtration of the Water Supply."** Early reports recommended filtration of water supply before sewage disposal. At present the city has a modern sewage disposal plant, built recently, and the filtration question is still undecided.

Arthur E. Gorman, of the Chicago Water Department, reviewed the very interesting paper prepared in collaboration with Abel Wolman on the **"Significance of Water-Borne Typhoid Outbreaks."** He outlined the reasons for many typhoid and dysentery outbreaks, and classified the outbreaks as to cause. The paper in full has been published in the proceedings of the American Public Health Association.

EDITORIALS

Mechanical Treatment

WE speak of the electrical age as that through which the world is now passing. The *mechanical treatment era* is likely to be the term applied by our descendants in referring to this particular period in the development of water purification and sewage treatment.

In reality the mechanical phase would be insufficient without the chemical, but it seems that we are finding improved mechanical treatment all important from the economical side of the purification problem. In addition, when applied in water treatment it goes further than effecting reduced operating costs: it produces with-al a superior finished product. In sewage treatment the mechanical phase is of primary importance in reducing operating costs: it may or may not improve the quality of effluent.

Elsewhere in this issue, John Baylis, of the Chicago Experimental Filter Plant, in discussing filter-bed troubles, such as the appearance of mud balls and hard spots, lays stress on the importance of efficient coagulation of the raw water if these undesirables are to be prevented. Most enlightened operators concur with him in his belief that filter-bed troubles, as a rule, result from no fault of the filter, but rather in faulty preparation of the water applied to the filters.

Not satisfied with the improved efficiencies produced by baffled mixing chambers, chemists and engineers have gone further and perfected several modifications of mechanical mixing and coagulating devices. One type of mixing device—that reported upon by Richard F. Wagner of Lynchburg, Va., on another page of this issue—incorporates aeration by air aspiration. With one operation the entrained air produces a thorough mixing of coagulant or other chemicals with the water and sweeps out gases, including much of the carbon dioxide, and odors. Another type of mixing device has been installed at the Brownsville, Tex., filter plant. Diffused air is applied from a compressor.

Not satisfied that there was a really "best" coagulating device available on the market, M. C. Smith of Richmond, Va.—as described in the first article in this issue—has developed and installed mechanical "flocculators" just beyond the high velocity mixing chambers at the Richmond plant. This installation represents a super effort to de-colloidize water. The series of "barrel rolls" given the water, at right angles to its path of flow and at gradually decreasing velocity of roll, seems to have been most effective in producing efficient mechanical flocculation at low power cost. The comparative results and reduction of coagulant reported would seem to prove the claims of advocates of mechanical treatment even to the extent of going to comparative extremes in that direction, such as the 70-minute period of flocculation practiced at Richmond.

Is it far fetched to suggest, that we might do well to convert 25 to 33 per cent of the now accepted volume requirement of coagulation basins to "flocculation" basins and thus create a "floc" which will drop out very rapidly in the remaining part of the basin, and with the resulting effect that even with reduced subsidence the filter load and chemical cost will be markedly reduced? Will not the filtered water quality consequently be improved to the extent that less colloidal products will remain to create tastes and odors or to mask the natural brilliance of *pure* water. Those, at least are indicated, as the result of Richmond's experiences with super mechanical treatment.

Mechanical treatment which produces, first a thorough distribution of chemical, and thereafter produces a motion through the body of water which will produce the maximum number of gentle impacts of particles, can but produce the most effective flocculating or agglomerating action—because it puts into force one of the immutable laws of physical-chemistry which holds for the laboratory beaker as well as the Richmond coagulating basins.

From water coagulation to sewage flocculation in the activated sludge process is not a far jump. The maximum work done in the latter process comes about as result of numerous and effective contacts between the floccular adsorptive sludge and the colloidal matters dispersed throughout the sewage. In an article by R. F. Goudey, that will appear in the next issue, it is pointed out that mechanical paddle wheels rotating in the aerating tanks have improved the efficiency of the activated sludge process and at materially lower costs for power consumed. Is it far fetched to attribute these results to an assumption, that among other things, the mechanical mixing of the returned and continuously forming sludge floc through the sewage is more effectively and economically accomplished by mechanical devices than by the air lift principle, i. e., by diffused air alone? As a matter of fact the economical results at Los Angeles, Chicago and elsewhere have been secured by a small quantity of diffused air, plus a large quantity of mechanical mixing. That prevents short circuiting and increases the number of contacts between sludge floc and dispersed organic products and brings into force the purging effect of the adsorptive sludge floc added.

With mechanical mixing effectively applied much may be anticipated in the way of improved effectiveness and reduced expense of chemical precipitation processes applied in sewage treatment which were not attained in previous experiences with this form of treatment.

From now on the advances in the art of water purification and sewage treatment may be primarily contingent on improved mechanical treatment. The benefits derived to date from improved mechanical treatment are already impressive.

▼

Good Management

INDICATIVE of good management is the earnings report of American Water Works & Electric, Inc., for the year 1931.

Net income of $6,104,194 is reported for 1931 before deduction of a non-recurring income item of $294,972. The net was equal after preferred dividends to $2.80 a share on the common stock. Including the non-recurring item the net was equal to $2.97 per common share. In 1930 net income was $6,623,647 or $3.10 per share on the common.

Income reduction of water works companies on the whole has been primarily caused by dropping off of water consumed by industry. The high price water sold for domestic consumption has fallen off less than 10 per cent on the average.

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What *is* it?

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What does it *cost to apply?*

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IN TOKYO

Dorr Clarifiers Are Being Installed In The Shibaura Sewage Treatment Plant

DORRCO

The first step in the modernization program at the Shibaura Sewage treatment plant in Tokyo is now under construction.

This is a straight sedimentation plant and sludge from plain tanks is sent to storage tanks and later barged out into the bay for discharge.

To relieve overloaded conditions at the plant and eliminate the unsightly and offensive conditions caused by sludge rising in the plain tanks, 3-150 ft. Dorr Traction Clarifiers are being installed

THE DORR COMPANY, INC.

ENGINEERS

247 PARK AVENUE, NEW YORK CITY

DENVER CHICAGO LOS ANGELES WILKES-BARRE ATLANTA TORONTO

LONDON: The Dorr Company, Ltd. (Licensee)

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PARIS: Societe Dorr et Cie (Licensee)

MELBOURNE: Crossle & Duff Pty., Ltd.

TOKYO: Andrews & George Co., Inc.

JOHANNESBURG: Edward L. Bateman, Pty., Ltd.

JUST SUPPOSIN'! THE A. W. W. A. HADN'T GONE AND GROWD UP!

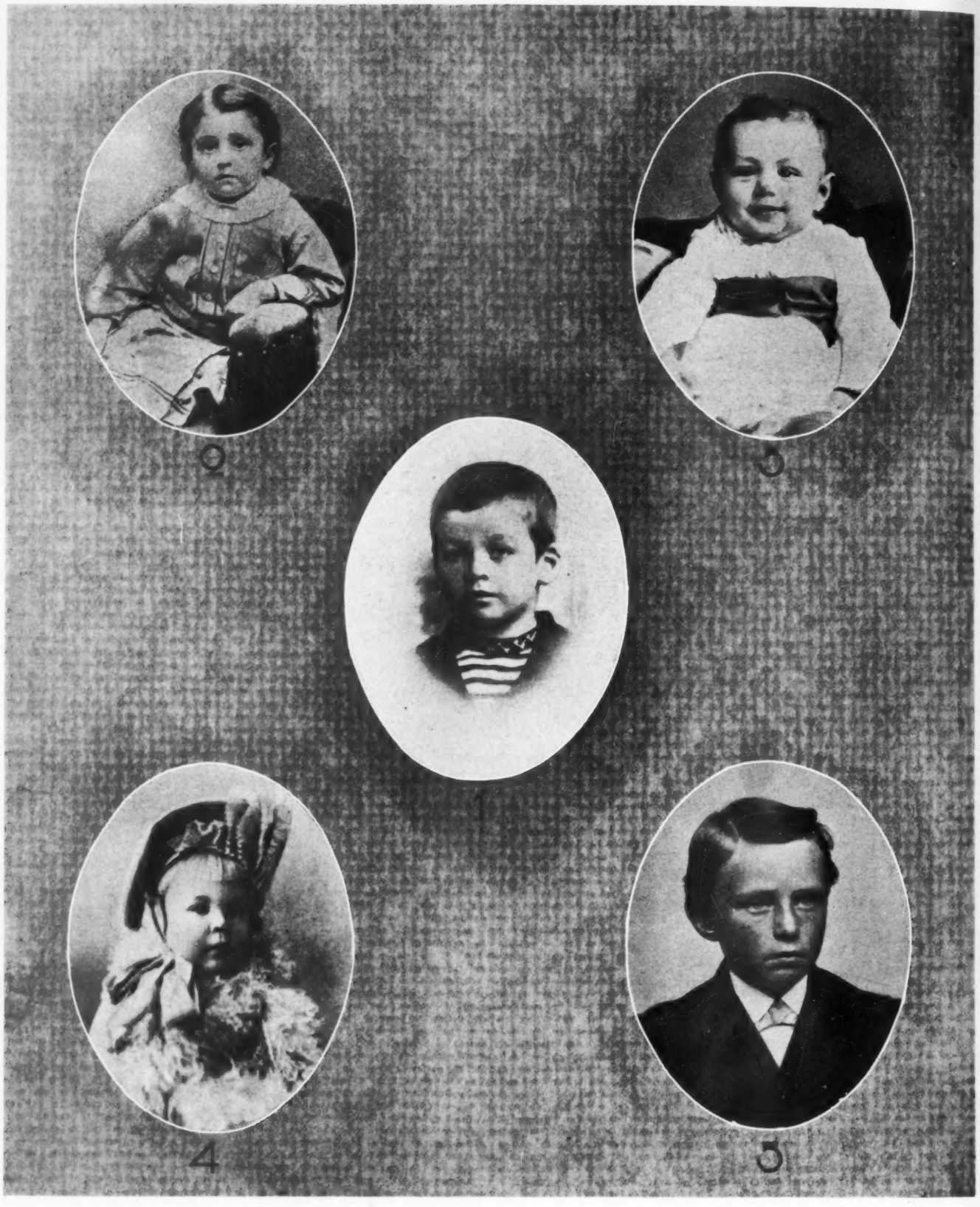
The pictures on the pages that follow are those of men prominent in the activities of the American Water Works Association before they "WENT AND GOT GROWD UP".

●

ON BEING BOYS AGAIN

Come old man, you and I
We'll steal an hour from days gone by—
The shining days when life was new
And all was bright as morning dew.
The lusty days of long ago
When you were Bill and I was Joe.

—OLIVER WENDALL HOLMES.



1. Ross L. Dobbin, Peterborough, Ontario, President A. W. W. A., 1931-1932, Diven Medalist 1930.

2. Beekman C. Little, Rochester, New York, Secretary A. W. W. A.

3. Wm. W. Brush, New York, N. Y., Treasurer, A. W. W. A.; Past President 1928-1929; Member Executive Committee.

4. Malcolm Pirnie, New York, Chairman Water Works Practice Committee; Member Executive Committee; Diven Medalist 1931.

5. Geo. W. Fuller, New York, N. Y., Past President A. W. W. A. 1923-1924; 1st Diven Medalist 1926; Chairman Committee 3.

6. Geo. W. Pracy, San Francisco, Calif., President-elect A. W. W. A. 1932-1933; Committee Water Works Practice.

7. Stephen H. Taylor, New Bedford, Mass., Member Board of Directors; Member Executive Committee.

8. Paul Hansen, Chicago, Illinois, Chairman Water Purification Division 1931-1932; Chairman Committee on Water Treatment.

9. A. V. Ruggles, New York, N. Y., Ass't Secretary A. W. W. A.; Secretary Water Works Practice Committee.

10. Harry E. Jordan, Indianapolis, Indiana, Secretary Water Purification Division and Past Chairman.

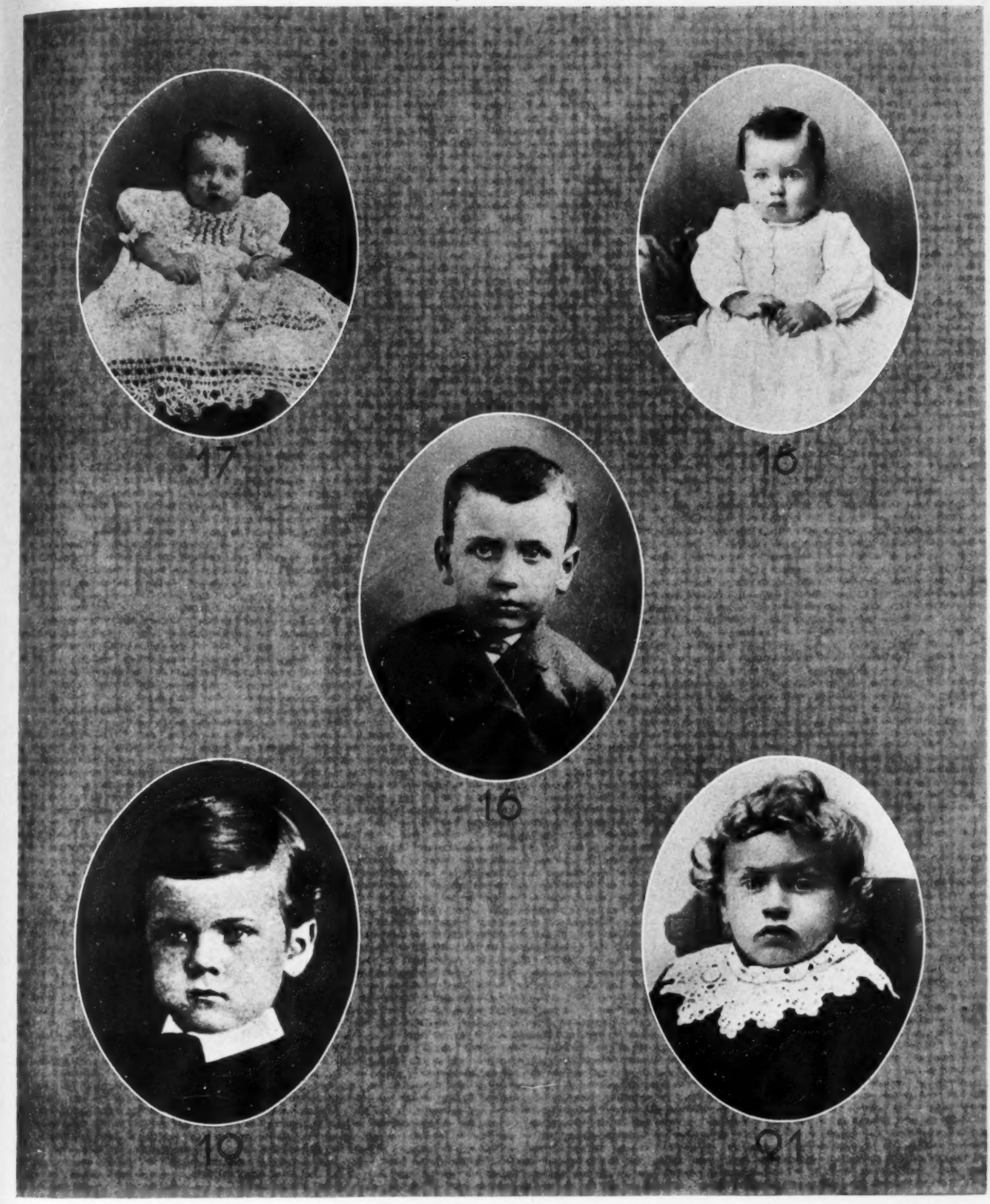
11. W. S. Cramer, Lexington, Ky., Past President 1922-1923; Diven Medalist 1928.

12. S. B. Morris, Pasadena, Calif., Member Board of Directors; Member Publication Committee.

13. A. F. Porzelius, Chattanooga, Tenn., Member Board of Directors; Chairman Maintenance and Operating Division.

14. C. A. Emerson, Jr., Philadelphia, Pa., Past Chairman Publication Committee.

15. Thos. J. Skinker, St. Louis, Mo., Member Board of Directors.



16. Jas. E. Gibson, Charleston, S. C., Past President 1927-28; Diven Medalist 1929.

17. C. W. Smedberg, Greensboro, N. C., Member Board of Directors.

18. L. A. Smith, Madison, Wis., Member Board of Directors.

19. J. W. Armstrong, Baltimore, Md., Chairman Committee on Filter Sand; Past Chairman W. Purification Div.

21. N. T. Veatch, Jr., Kansas City, Mo., Member Publication Committee.

21. Col. Edward Bartow, Iowa City, Iowa, Past President A. W. W. A. 1921-22.

22. E. D. Case, New York, N. Y., Secretary-Treasurer New York Section A. W. W. A.

23. W. E. Vest, Charlotte, N. C.

24. L. R. Howson, Chicago, Illinois, Chairman Committee Standpipes and Tanks.

25. A. L. Fales, Boston, Mass., Past Chairman Water Purification Division; Chariman Committee on Industrial Wastes in Relation to Water Supply.

26. Jack J. Hinman, Jr., Iowa City, Iowa, Past President 1929-1930; Chairman Committee No. 1.

27. Jas. F. Sanborn, New York, N. Y.

28. Burt. B. Hodgman, New York, N. Y., Permanent Chairman Entertainment Committee.

29. V. Bernard Siems, New York, N. Y., Chairman Legislative Committee, A. & F. Div. Convention Committee.

30. John C. Pritchard, St. Louis, Mo.

31. Robert Spurr Weston, Boston, Mass., Honorary Member A. W. W. A.; Past President N. E. W. W. A.; Chairman Committee on Manganese and Iron Removal.

32. Harrison P. Eddy, Boston, Mass., Honorary Member N. E. W. W. A.; Chairman Committee on Water Works Betterments and Federal Aid.

33. M. N. Baker, New York, N. Y., Committee No. 5.

34. Guy C. Northrop, New York, N. Y., Chairman Convention Exhibit Committee.

35. L. M. Booth, Elizabeth, N J.

WATER WORKS MANUFACTURERS' ASSOCIATION.

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37. Chas. H. Becker, R. D. Wood & Company, Philadelphia, Pa., Vice-President.

38. John A. Kienle, Mathieson Alkali Works, New York, N. Y., Secretary.

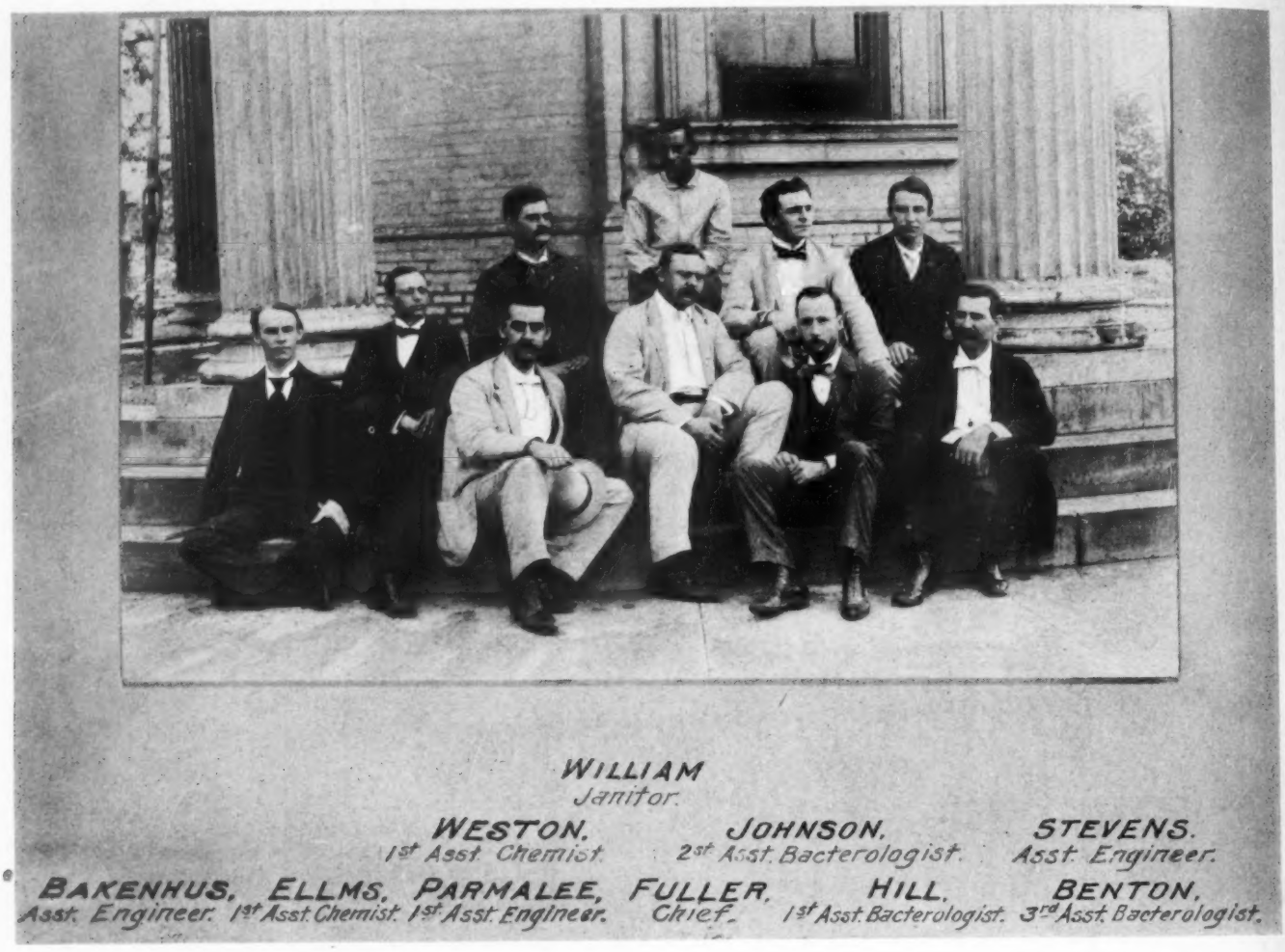
39. Edgar Buttenheim, American City, New York City, Treasurer.

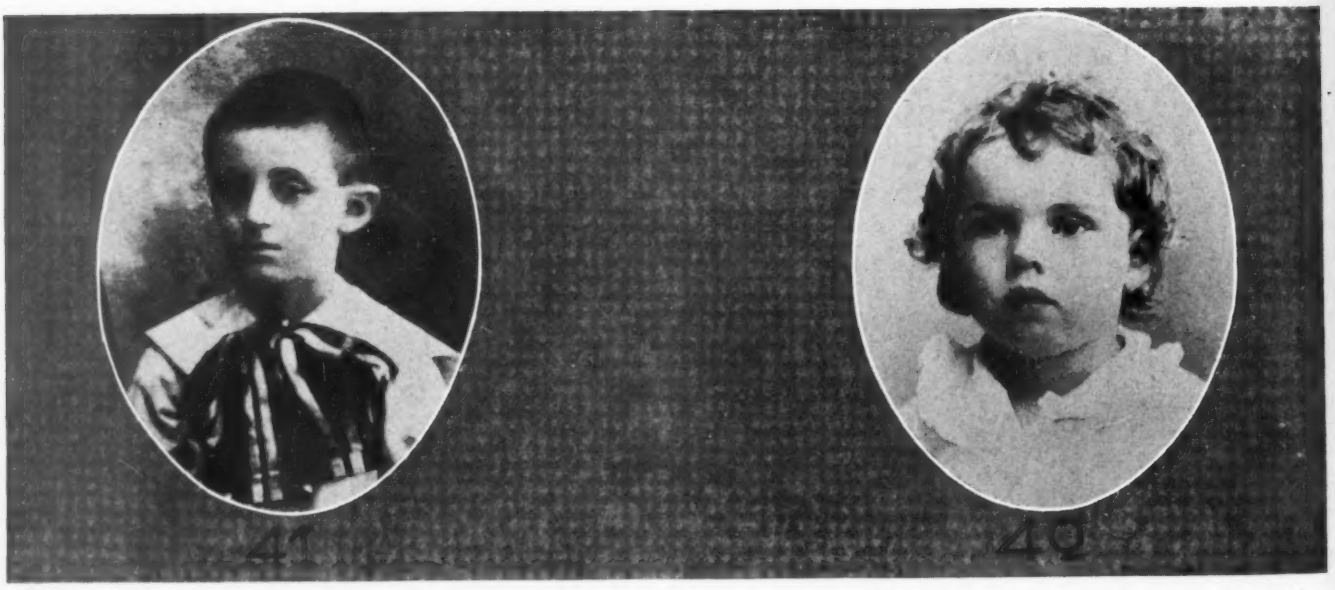
40. S. W. Jacobs, Electro Bleaching Gas Co., New York, N. Y., Convention Committee; Past Chairman Registration Committee.

Louisville Water Co., Experimental Station Staff, 1896

MAKING HISTORY AT LOUISVILLE, KY., 1896.

This Group of Experts Put Rapid Sand Filtration "on the Map" as a Result of the Experimental Tests Conducted at Louisville. Do You Recognize: Geo. W. Fuller, New York, "Chief"; Geo. A. Johnson, New York, "Bacteriologist"; Robert S. Weston, Boston, Mass., "Chemist"; Jos. W. Ellms, Cleveland, O., Chemist?





41. Abel Wolman, Baltimore, Md., Editor: Journal of the A. W. W. A.; Committee Water Works Practice; Publication Committee.

42. Linn H. Enslow, New York, N. Y., Vice Chairman Publication Committee; Committee No. 1; Committee No. 5.

AERATION AND MIXING DEVICE

ACCOMPLISHES MARKED SAVINGS AND EFFICIENCIES AT LYNCHBURG, VA.

By RICHARD F. WAGNER
Director,
Safety and Water,
Lynchburg, Va.

THE city of Lynchburg, Va., secures its water from Pedlar River, a mountain stream draining a valley located 30 miles north of the city and to the south of the Blue Ridge in Amherst County. A concrete masonry dam 60 ft. high impounds this stream forming Pedlar Lake. The total storage is 600 million gallons. A 30-in. conduit 21 miles in length delivers the daily requirements, by gravity, to the purification plant in Lynchburg, located on what is known as College Hill, from which the flow to the distribution system, normally, is by gravity also.

Type of Purification

Coagulation of the supply is secured by means of alum, with the occasional use of soda ash, such chemicals being injected into the raw water supply main by Gould triplex pumps. A concrete tank, or tower, 50 ft. in diameter and 60 ft. in height serves the double function of coagulation and sedimentation. After the water enters the top of this tower, the flow is downward for 2½ hours—passes under an annular concrete baffle ring—then rises for a like period to the collector ring at the top of the tower, thus affording five hours of retention period. The settled coagulated effluent is filtered in the filter house below through 12 Roberts pressure filters, each of a rated capacity of 500,000 gal. daily. The filter house is shown to the right of the coagulating tower in Fig. 4. This gives a static pressure of 24 lb. at the highest point in the distributing system, thus obviating any pumping the major portion of the year. The supply from Pedlar Lake is unusually pure, soft and uncontaminated. Sterilization is necessary at rare intervals only. Liquid chlorine is applied to the filter effluent if and only when needed.

Original Aeration

The majority of impounded water supplies are subject, during certain portions of the year, to odors and

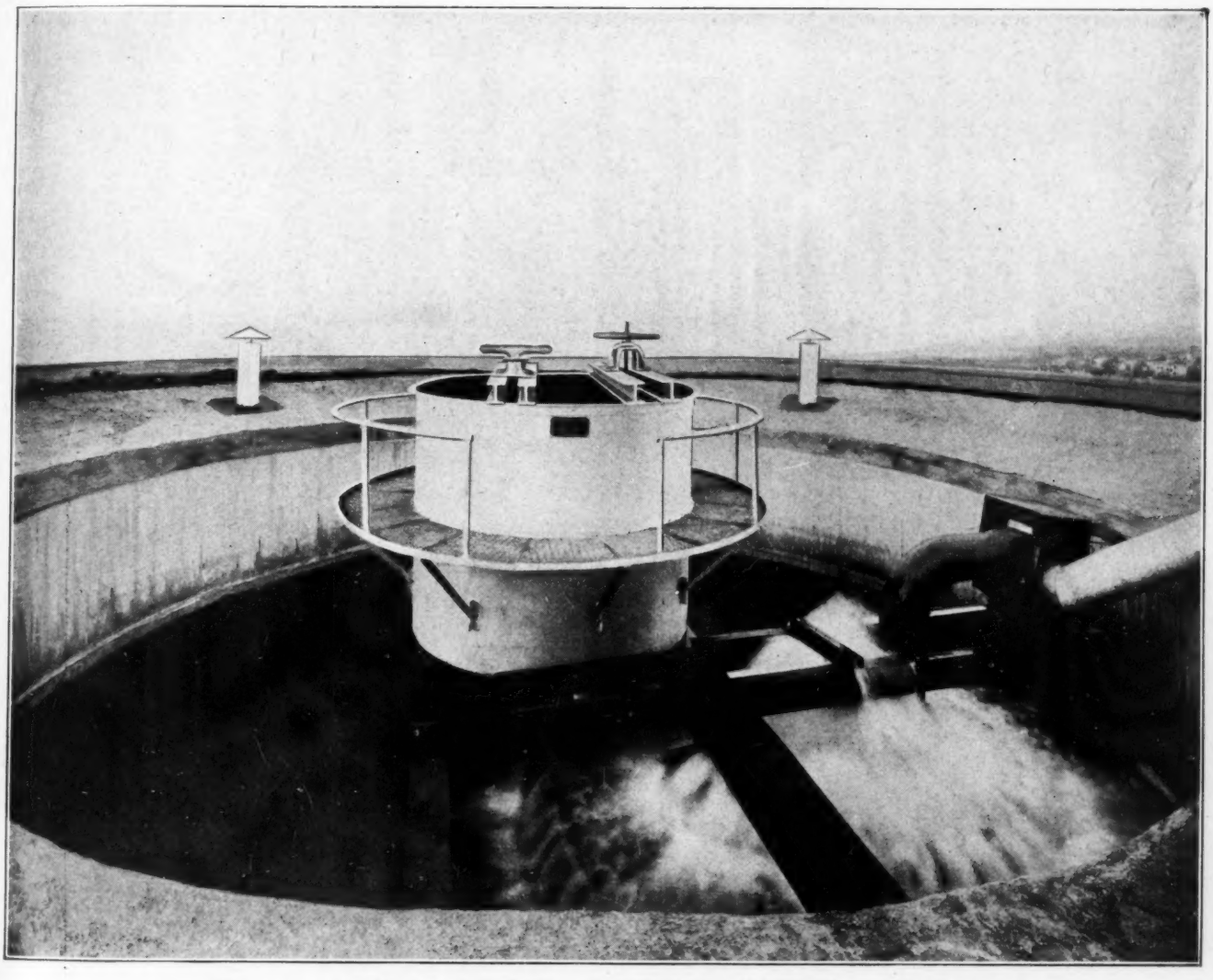


Fig. 1. Aer-O-Mix Discharge Plate and Header Tank, Lynchburg, Virginia, Effecting a Net Annual Saving of $1600.00.

tastes—as well as carbon dioxide. The Lynchburg supply is no exception. Such characteristics may result from the decomposition of organic matter, again they may be traced to living microscopic organisms. Carbon dioxide gas in our supply causes very objectionable corrosion, with attendant complaints of "red water." Since 1919, these objectionable odors, tastes and gases have been removed very successfully through the aeration of filtrate by means of spray nozzles. These nozzles, of the whirling spray type, are located in the center of a filtered water basin 350 ft. in diameter (shown in Fig. 3). This large area enables most of the spray to be saved and not blown away. Such aeration provided an opportunity for the interchange of gases and volatile substances and atmospheric oxygen. This interchange naturally resulted also in the removal of carbon dioxide.

Fig. 2. Pedlar Dam and Spillway—Recently Raised 7 feet by Lynchburg Water Department on account of 1930 Drought.

Cost of Aeration

While this aeration was eminently successful, it was by no means economical. The 50 ft. of gravity head dissipated naturally had to be restored by pumping. The average power cost of this pumping, over a period of ten years amounted to $1750 annually—rising each year. Aeration was resorted

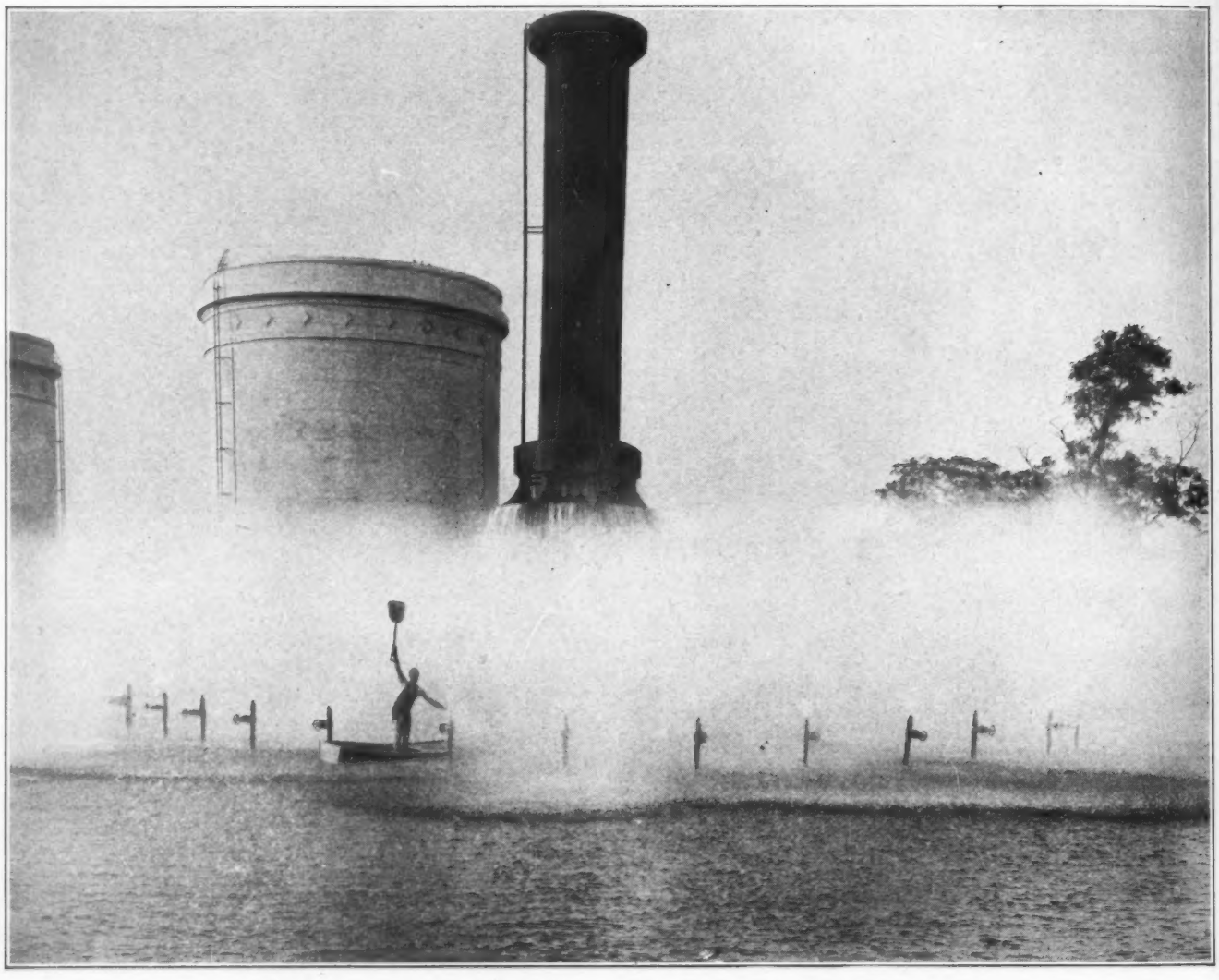


Fig. 3. Spray Pond, Lynchburg, Va. (used until December, 1930) Dissipating Over 50 Feet of Head.

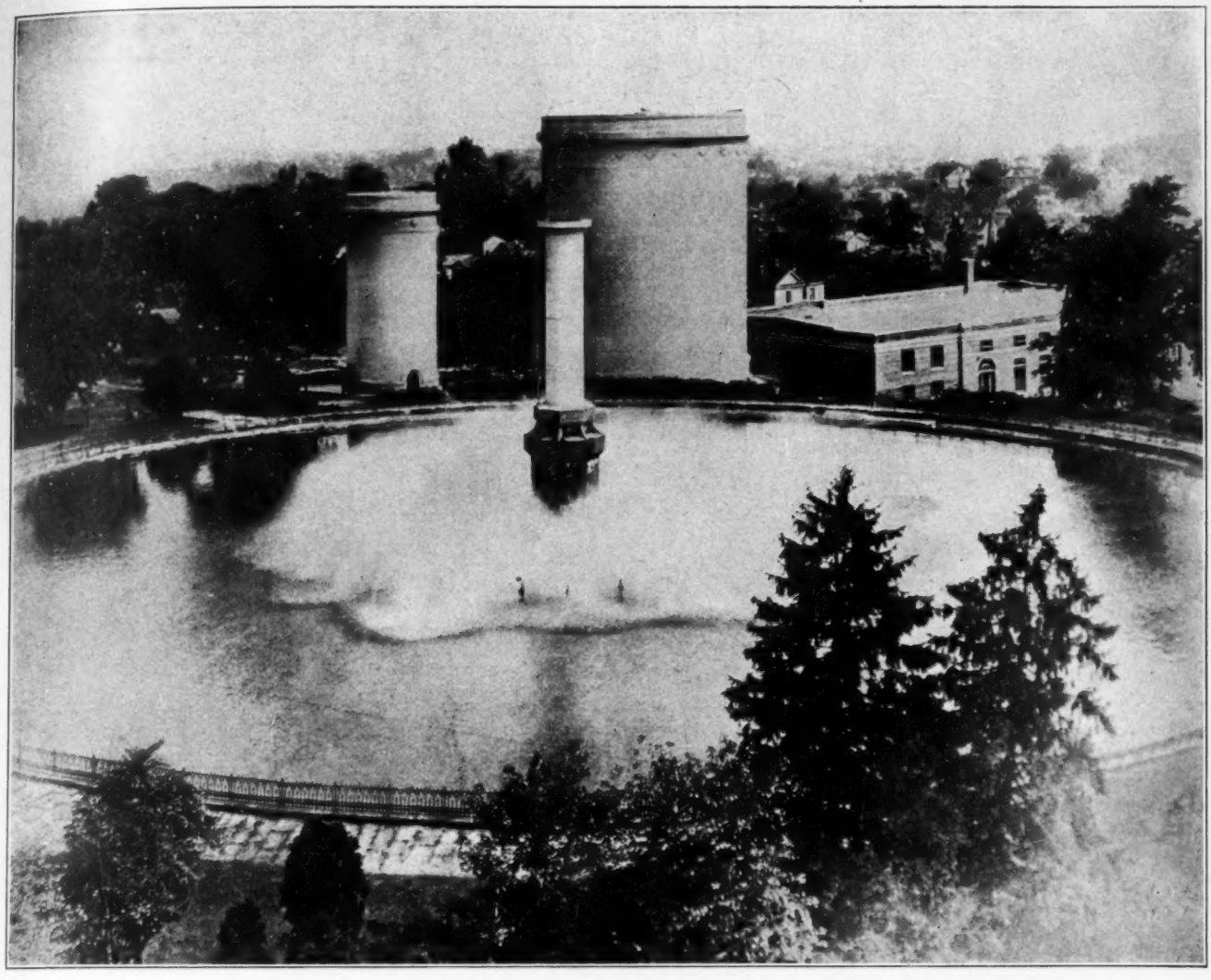


Fig. 4. Airplane View of Original Lynchburg, Virginia, Purification Plant. This Plant, with Vertical Coagulation Tower, Pressure Filters, and Aer-O-Mix is now a Complete Gravity System. No Pumping is done of Filtrate.

to for an average of only 70 days a year, requiring therefore, an actual expenditure of $25 a day during its operation. There remained, however, certain days during the year when it became necessary to reduce the carbon dioxide present—and because of the spray nozzle aeration cost, it was cheaper to accomplish this by applying soda ash to the filter effluent. The cost of such treatment averaged $300 annually. In short, the reduction of carbon dioxide, odors and tastes was accomplished for the cost of approximately $2050 annually.

Investigation of the Merits of Aer-O-Mix

During the Summer of 1930 there was brought to our attention an aerating and mixing device manufactured by the Vogt Brothers Mfg. Co. of Louisville, Ky., under the trade name of "Aer-O-Mix." In such device air at atmospheric pressure is drawn in from the air intake by the water flowing past numerous bronze tube ends into a specially designed orifice or throat where a rapid breaking up, and uniform diffusion takes place.

The air being under pressure equivalent to the head of water above it—and having a gravity of about 1/800ths that of the water—would normally rise to the surface, but is unable to do so by the downward velocity of the water. Because of such tendency of the air to rise, agitation and thorough mixing result. Air bubbles are constantly reduced in size, broken up and compressed by the weight and downward flow of water above them. This mixture of air, water and chemical is held entrained and violently agitated throughout the U-tube of the Aer-O-Mix.

In the vertical riser tube a specially designed spiral is inserted, where, acting with the added advantage of air lift, the mixture rises—agitated once more as the air expands—and the excess air escapes and passes off into the atmosphere upon reaching the surface, as the effluent flows over a circular discharge plate with roughened surface.

The principle utilized in the Aer-O-Mix does not differ from other methods of aeration. But instead of finely dividing the water by spraying or cascading, which demands the dissipation of a large head of water, the Aer-O-Mix system draws down the air continuously, in great volume, finely divided, through many hundreds of air tubes located in the intake manifold, or header, with the gravity flow of the water—thus using the suction principle of multiple inspirated tubes.

The manufacturers of Aer-O-Mix suggested that this apparatus would do the following:

1. Could be located at the top of the vertical coagulating tower to receive all the raw water for aeration and improved coagulant mixing.

2. The water level could be maintained as heretofore in coagulating tower—Aer-O-Mix deriving its 8 ft. of operating head from gravity raw water line.
3. Aer-O-Mix would operate the year round without respect to climatic conditions, winter and summer; even though exposed to the atmosphere and without supervision.
4. Would accomplish with 8 ft. of free gravity head, handling raw water, the same complete taste and odor removal as the spray aerators dissipating 50 ft. of head of filtered water; and with substantial reduction of carbon dioxide.

Experiments with a small model set up at the purification plant demonstrated the feasibility of the device, as applied to the local supply. As a consequence, an Aer-O-Mix of a capacity of 6 million gallons daily was installed at the discharge end of the 30 in. supply main on top of our coagulating and sedimentation tank, and placed in operation during December, 1930. Provision was made in the Aer-O-Mix header tank for an additional unit to be added later, as our demand increased.

RESULTS OF AERATION BY "AER-O-MIX"

As the result of the operation of Aer-O-Mix, the City of Lynchburg, during 1931 effected the following savings and efficiencies:

1. Difference between previous annual power costs, and the fixed charges on the Aer-O-Mix investment, results in saving a net sum of approximately $1600 for the year.
2. A potential saving in the cost of chemicals because of better mixing facilities and consequent reduction in the amount of chemical dose, and also improved sedimentation.
3. Raw water may now be drawn from lower levels in Pedlar Lake where temperatures are lower, thus giving our consumers a cooler supply. Such water in the summer time is usually charged with iron in solution, and Aer-O-Mix oxidizes the dissolved ferrous into the insoluble ferric iron, which is coagulated and subsequently removed by filtration.
4. Aeration is now a continuous every day process rather than being used, as was formerly the case, during a short period of the year only, thus being an important factor at all times towards the production of a palatable supply.

While the usual characteristic tastes and odors were present in the raw water during the summer of 1931, Aer-O-Mix completely removed such objectionable qualities and coincidently reducing the amount of carbon dioxide materially.

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Sixth Annual Meeting Florida Section, A. W. W. A.

The Sixth Annual Meeting of the Florida Section, A. W. W. A., was held in St. Petersburg, March 16-18, 1932, headquarters being at the Sewannee Hotel. The convention proper was preceded by a round table on problems of interest to Florida water works operators and superintendents, conducted by Professor A. P. Black, of the Chemistry Department, University of Florida, Gainesville. Wednesday afternoon and evening were devoted to the discussions, which were well attended and created a great deal of interest.

The convention proper was opened on Thursday morning by Chairman F. W. Lane, Superintendent of Water Works at St. Petersburg, Fla.

Papers and Discussions

The following papers were read and discussed:

D. S. Wallace of the U. S. Geological Survey at Ocala, Florida, reported on **"The Drought of 1931 in Florida"** and his paper was discussed by Herman Gunter, State Geologist.

Keith R. Chinn, Chemist of the West Palm Beach Water Company spoke concerning **"Hydrogen Ion Concentration and Free Alumina Determinations"** which Prof. A. P. Black discussed.

In the afternoon H. S. Hutton of the Wallace & Tiernan Company gave an illustrated talk on **"Ground Water Supplies and Pollution Hazards,"** which Mr. Gunter discussed most ably.

"Algae Conditions, Control and Remedies" was the topic covered by M. A. Norris, Chemist, Orlando Utilities Commission and a general discussion followed.

F. E. Stuart, of the Industrial Chemical Sales Company spoke on **"Sludge Stabilization with Activated Carbon"** disclosing very interesting observations in that direction.

"Changes in Filter Plant Operation and Success of the Chlorine Ammonia Treatment" was the subject of a report by J. C. Chalfont, Superintendent of Water Works at Fort Lauderdale.

J. E. Lyles and A. R. Murphy were the leaders in the discussion of Mr. Chalfont's remarks. The use of ammonia-chlorine treatment at Mr. Lyles' plant had given very satisfactory results.

J. E. Lyles, Chemist of the Tampa Filtration Works read a paper on **"Dead Spots in Distribution Systems"** which Mr. F. W. Lane of St. Petersburg, discussed.

"What Should Government Cost?" was the subject of a talk by W. M. Cotton, City Manager of St. Petersburg.

"Budgetary Control of Expenses" was discussed by Paul De Moya, Superintendent, Consumers' Water Company at Stuart, Florida, and **"Revenues"** was the subject of an open discussion led by R. W. Reynolds, General Manager, West Palm Beach Water Company.

T. M. Early, Superintendent Water Works at Cocoa, Florida, told of the **"Value of the Association to Small Water Works Operators."**

The closing paper was that presented by A. P. Michaels, Manager, Orlando Utilities Commission on the ever interesting subject of **"Public Relations"** which was discussed by F. H. Owen, President, Pinellas Water Company, Jacksonville, Fla.

The section was honored by a visit from the president of the American Water Works Association, R. L. Dobbin, of Peterboro, Canada, who was the guest of honor at the annual formal banquet and dance held on Thursday night at the Don-Ce-Sar Hotel at Pas-a-Grille. Mr. Dobbin spoke to the Section on "Association Affairs." Professor A. P. Black made an able toastmaster.

Hollywood, Fla., was chosen as the place for the 1933 convention and the following officers were elected for 1932-33:

Chairman: Herman Gunter, Tallahassee, Fla.
Vice-Chairman: J. E. Lyles, Tampa, Fla.
Secretary: Louva G. Lenert, Jacksonville, Fla.

Two new directors were elected—F. W. Lane, St. Petersburg, Fla., and W. A. Smith, Jacksonville, Fla.

THE DISCREDITED FILTER

By CHURCHILL HUNGERFORD
President, Hungerford & Terry, Inc.,
Clayton, N. J.

Churchill Hungerford

THE closing years of the last century and the early years of the present one represented a period when the slow sand filter had reached its full development and the mechanical filter had begun to demonstrate its fitness for municipal filtration plants.

The water filter was then generally regarded as an able and efficient instrument for guarding the public from water borne diseases.

While the slow sand filter was demonstrating its capabilities so well the mechanical filter was fighting its way upward toward recognition for the filtration of municipal supplies. The mechanical filter by reason of its cheapness, ease of operation and its general effectiveness moved rapidly forward and eventually almost completely superseded the slow sand filter for new installations. The excellent bacterial efficiency of these filters permitted their adoption in most of the water works systems.

The design of mechanical filters was originally exclusively in the hands of the manufacturer of filters and it was customary for him in dealing with a municipality to give a guarantee of the efficiency of his filters.

The filter manufacturer's guarantee was a difficult one to meet. Little was known about coagulation, less about agglomeration of floc and nothing about the influence of the hydrogen ion concentration upon coagulation. Coagulating basins were almost universally too small and sedimentation was worse than inefficient.

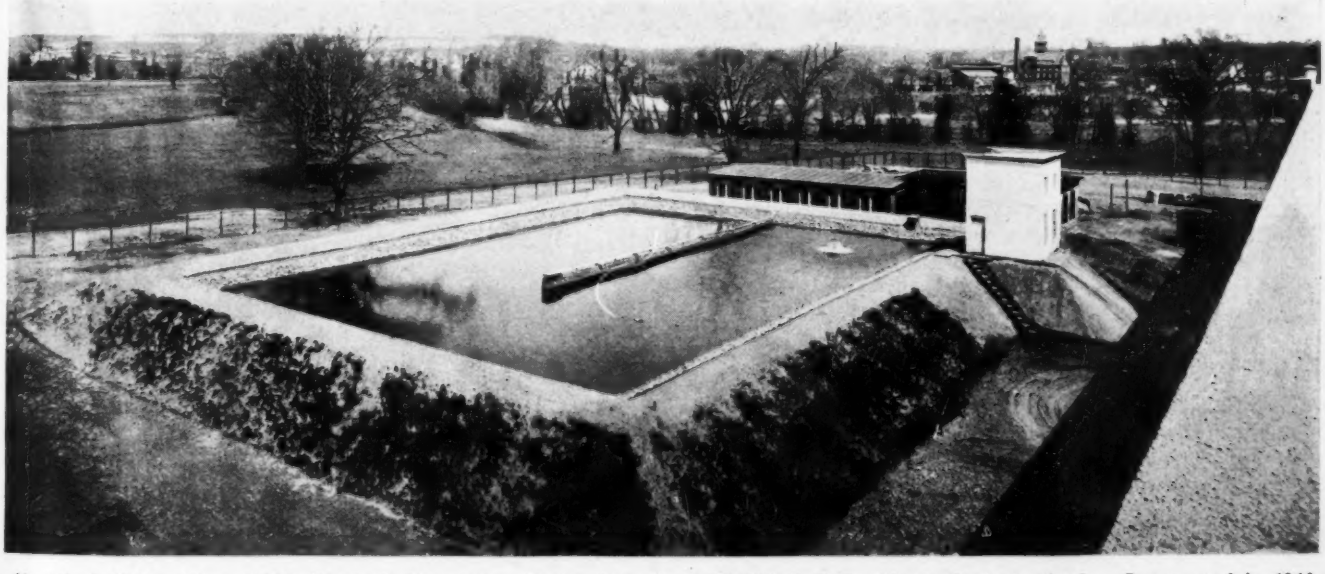
In the face of these difficulties the filter performed creditably. Every manufacturer was literally on his toes to make improvements and alterations to his filter that would increase its efficiency. The size of the sand, strainers and strainer systems appeared to be the points where the most progress could be made and these features were most excellently developed. As a result the filter gave a safe and satisfactory water although frequently called on to filter water that the present state of the art of preliminary treatment would never permit to go to a filter.

To produce such results it was necessary to invent and develop efficient strainers that would not become choked up and thus prevent proper washing. It was early discovered that gravel layers were necessary to produce distribution of wash water between strainers and to prevent the strainers from being damaged by sand. It was found that the grading of the sand had a mighty influence upon the effectiveness of the filter, and above all it was found that an auxiliary agitation of the sand during washing, other than that given by water, must be employed to preserve the life and effectiveness of the filter bed.

Then came the injection of chlorine into the water purification problem in 1908 at the Chicago stock yards where the water from Bubbly Brook was filtered for cattle to drink.

It is interesting to observe that this first case of chlorination was one of prechlorination and that the chlorine was applied for the protection of the filters rather than to obtain bacterial efficiency. As a natural sequence, chlorine was tested as a bactericide in filtered water with such success that its use spread rapidly throughout the country.

Unfortunately, because chlorine is so efficient a bactericide there has gradually developed a strong tendency to rely too strongly upon the chlorine and to accept almost anything from a filter plant that looks reasonably good. Little else seems to be required. As a result, there has been no incentive to maintain the old



Air Wash Filter Plant With Earth Sedimentation Basin, Capacity 2,000,000 G. P. D., Cluett Peabody & Co. Constructed in 1910 by Hungerford & Terry, Inc.

standards of excellence given by filters, and inferior and misconceived designs have been put forward and accepted. Although these latter have the advantage of all the advancements in coagulation, mixing, etc., the results given by them are frequently far below those of the older type of filter.

If Boards of Health, sanitarians and others in authority will demand a high standard of filtration and will not accept chlorine merely as a work horse to cover up the deficiencies of the filters we may expect to see a very great improvement in filters.

The blame for the discredited filter of today can be divided equally between health boards who accept mediocre or worse performance from the filters, filter designers who only half grasp the principle of the high-velocity-wash, and filter manufacturers who, although knowing better, will complacently adopt any design so long as they can make money by it.

To the engineering profession, much must be said and most of it appertains to the fetich of high velocity washing of filters.

The high-velocity-wash is regarded by most engineers as a comparatively recent development. It may be news to some designers of filters that the high-velocity-wash filter was designed by that father of all filter-men, Isaiah Hyatt, in 1898. Hyatt's high-velocity-wash filter consisted of the customary Hyatt strainers, no gravel whatever, a bed of ungraded sand and an elevated tank that would deliver a large volume of wash water in a very short period of time and would, as the inventor expressed it, "tumble the bed over and over and over." Compare this plan with some of the most recent installations.

The present day high-velocity-wash assumes that an upward velocity equivalent to 15 gallons per square foot per minute is the minimum flow which will produce proper washing of the sand when no additional agitation other than that given by the water is provided. The old wash-rake filters, which had revolving agitators and which are still used extensively in industrial applications, employed 9 gallons per square foot per minute. With the 15 gallon high-velocity-wash filter partial failure takes place as is evidenced by cracks in the bed and the necessity for digging up and re-laying the entire filter bed at intervals ranging from one to three years. The old wash-rake filter runs on indefinitely with no cracking of the bed, no necessity for digging up the filter and a steady and uniform performance year in and year out. Few high-velocity-wash filters of the present day can begin to show the effectiveness of the old wash-rake filters when working under parallel conditions.

Unfortunately the wash-rake filter is of necessity of circular shape and occupies a vast amount of space for a given capacity. It is natural that a filter contained in a rectangular concrete basin would be preferable and it thus behooves all of us to design such a filter that is as effective as the old wash-rake type.

This has been done. It is as old, if not older, than Hyatt's high-velocity-wash filter. It is, with all its faults, the well known and much decried air-wash filter.

In discussing the relative characteristics of the high-velocity and the air-wash filters it is necessary to discuss two salient features, the gravel layers that are most important (and if the word is permissible) the most fatal part of any filter, and the sand bed that does the filtering.

In every filter the gravel layer ranges in thickness from 16 to 24 in. Based upon numerous experiments in glass containers it has been most effectually demonstarted that up-flow velocities of 15 gallons per square foot per minute will not disturb or disarrange the gravel layers.

Doubtless this is true as far as the glass containers are concerned, but undoubtedly it is untrue so far as filters are concerned. The drifting of the finer layers of gravel towards the ends of filters, the formation of mounds in the gravel and the ultimate breaking through of the sand into the coarse distributing layer and its appearance in the clearwell are phenomena that are all too familiar in most high-velocity plants that are three years or more old.

There must be some cause for the disturbance of the gravel other than a mere velocity given by 15 gallons per square foot per minute. It must be that there are places in the bed where the velocity is not only more than 15 gallons per square foot per minute, but is of a sufficient velocity to disturb the gravel layers. If not, why is it disturbed?

We are confined to the conclusion that when disturbance of the gravel bed takes place it is due to inordinate velocities in small sections and the only way these velocities could be obtained would be by a restriction of area in other portions of the gravel bed.

When this condition is reached uniform washing has been lost. Some of the bed washes actively and some of it does not wash. During filtration the washed portions of the bed would take the load and the unwashed portions do nothing. Two gallons per square foot per minute is an established standard for the rate of filtration and it is doubtless a good one, but when 50 per cent of the bed is inactive and still the standard quantity of water is being delivered the rate of filtration is no longer 2 gallons per square foot per minute but 4 gallons.

Prior to this the bacterial efficiency of the filter has been seriously impaired. Various organic substances that ought to be removed by the filter are only partially removed. Much oxidizable organic matter now appears in the water and the ever faithful chlorine plant is compelled to step into the breach and apply enough chlorine to burn up this matter and then attend to its legitimate duty of destroying the bacteria.

The other vital element is the filter sand. Because is was discovered 50 years or more ago that the medium which did most of the work in a slow sand filter was a mat of impurities upon the surface,—the schmutzdecke of the Germans,—this mat became a mighty element in the theory of mechanical filtration. Because it was able to withstand a velocity of 2,500,000 gallons per acre per day, its ability to preserve its integrity under a flow of 2½ gallons per square foot per minute was apparently unquestioned. Therefore it merely became necessary to lay down a thin layer of sand to act as a cushion for the schmutzdecke. Consequently only the surface sand in a filter was of importance to the filter designer.

Fortunately a more correct view of the process of filtration is now being taken and it is pretty thoroughly understood that filtration now takes place *in the bed* and *not on top of it.*

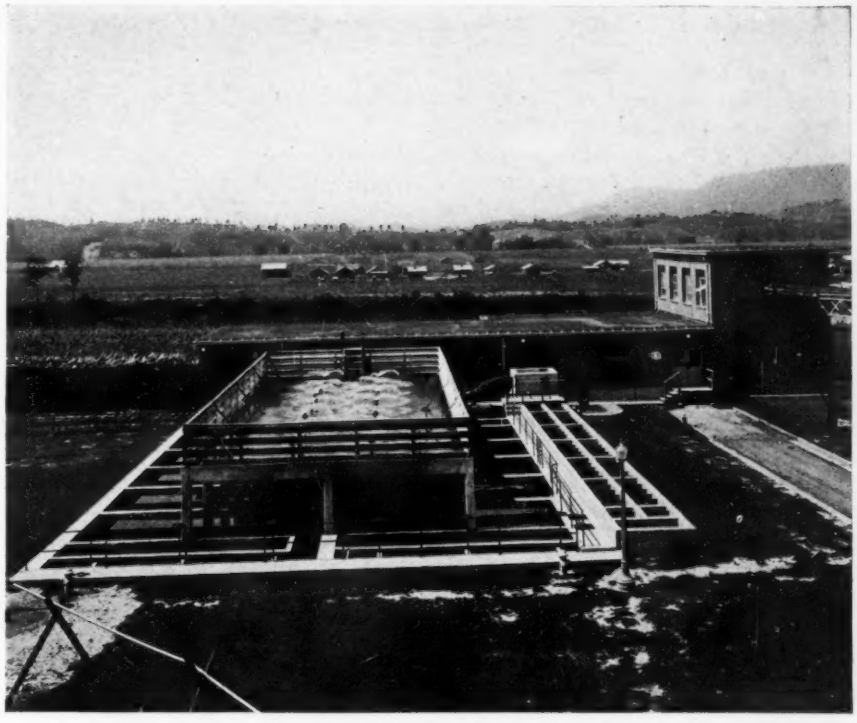
It is now necessary to elucidate a former statement that disturbance of the gravel may be attributed to the sand. The point to be further illustrated is that too fine a sand packs very densely and after being packed adheres very closely during the wash so that when the wash is first applied the bed breaks at far removed spots and all of the wash water rushes toward these breaks.

thus having a tendency to move the gravel.

It is easy to point out flaws in anything and mere fault finding leads to no end other than the discrediting of the fault finder unless a possible correction in the flaws is pointed out. The writer will thus endeavor to point out a remedy for disturbance of the gravel and still maintain a washing velocity of fifteen or more gallons per square foot per minute.

It has been shown (subject to debate) that 15 gallons per square foot per minute will eventually tear a gravel bed apart. The problem is to obtain 15 gallons per square foot per minute of wash water through the sand and relieve the gravel bed of such a high velocity.

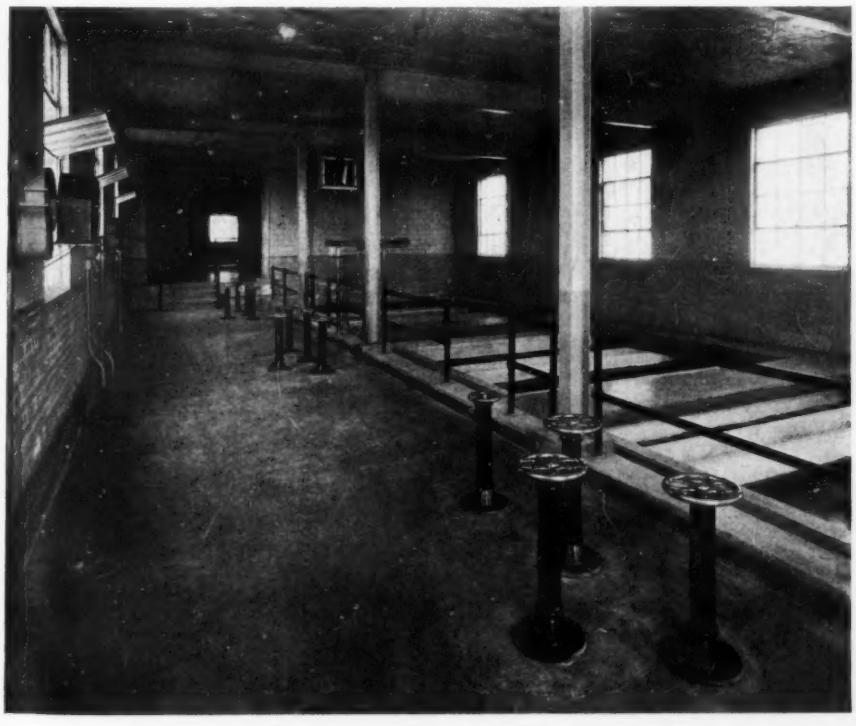
The solution is plain. It has been successfully employed since 1896. It consists in discharging 9 gallons per square foot per minute of water through the strainer system and in placing a separate system of air pipes on top of the gravel and below the sand and discharge through it 6 gallons of air per square foot per minute. This air system is not limited to 6 gallons, but that should be enough and 9 gallons of water plus 6 gallons of air equals 15 gallons of fluid going up through the sand and 15 gallons of air and water combined are more effective than 15 gallons of water alone. The agitation of the sand bed itself is not only improved by the air but the air carries the impurities driven out of the sand right to the surface of the water without any delay whatever. If a higher velocity of wash is required more air can be employed but it is inadvisable to increase the flow of wash water through the gravel above the 9 gallon rate.



Exterior 3 Million Gallon Per Day Gravity Air Wash Plant, Tennessee Eastman Corp., Kingsport, Tenn.

This plan is not a complete panacea for shifting of the gravel layers, but does greatly defer the evil day when a general re-laying of the gravel layers becomes necessary. There are instances where filters have functioned effectively and efficiently for 15 years before it became necessary to re-lay the gravel.

Those who have been compelled to build up-flow softeners for the last three or four years have learned much about gravel layers. It has been found that in spite of partitions, cellular construction, screens and what not that continuous rates of flow [never exceeding 7 gallons per square foot per minute] caused serious shifting of the gravel layers. It may be stated as a rule that the upward flow of water through the gravel layers of a filter will in time cause shifting of the gravel proportionate to the speed of the water through the gravel.



Interior 3 Million Gallon Per Day Gravity Air Wash Plant, Tennessee Eastman Corp., Kingsport, Tenn.

The remaining important point wherein improvement can be made in filters is the filter sand. A recent symposium held by the American Water Works Association upon the size of filter sand accentuated and further developed a fact known to many; that fine sand has a tendency to produce cracks in filter beds even though velocities of 15 gallons per square foot per minute and greater are employed. What was not especially developed at this symposium was the fact that fine sand is prone to form a mat upon the surface of the bed which acts as a piston to push the sand grains together so that if they are in the least coated with slime they will tend to adhere.

Without attempting to define the exact limits, the statement can be made

that sand that has an effective size of 0.50 to 0.60 m.m. and a uniformity coefficient not higher than 1.5 will not show a visible surface mat when filtering water that has received reasonably good preliminary treatment. *Where the surface mat is absent no cracking will take place.*

There is still some adherence to the old belief that the surface mat is the effective filtering medium. Those who adhere to this belief will have to struggle on with cracked filter beds and inefficient filtration. A theory was propounded some 25 years ago that rapid filtration is some kind of an entanglement process and that the bacteria and other suspended particles penetrate deep into a sand bed whose pores are infinitely larger than the particles themselves. Eventually, however, all of these particles sooner or later came in contact with a sand grain, which may be described as sticky, and there attached. Of course the sand grains near the surface retain by far the larger proportion of the impurities so that the interstitial channels become greatly reduced in area as the run progresses. The increased velocity of the water, thereby produced, tears loose much of this matter and carries it deeper in the bed and it again becomes reattached to the sand grains. This process continues until the filter becomes almost impervious to water or until some of the flocculated matter reaches the gravel layers.

Prior to the propounding of this theory Messrs. Chabal and Puech, working together in France, discovered that the turbidity of waters could be almost eliminated without a coagulant by repeated filtration through beds of pebbles the size of peas. The Massachusett's State Board of Health had also made the discovery that it was possible, although perhaps not practicable, to obtain a high bacterial efficiency without a schmutzdecke on gravel beds made of pebbles the size of split peas.

All this seems to indicate that we do not need the surface mat and in fact are infinitely better off without it where high rates of filtration are desired.

It is high time to consider our present methods. We are not building as well as we can. Our filters are not as good as they should be. The engineer is blindly following the fetich of the high-velocity-wash and the manufacturer of filters, who knows better, is satisfied to build anything that will bring him in revenue. Of the two, the filter manufacturer is the greater sinner.

very great improvement in filters. That the engineer and the filter manufacturer should use their best efforts to raise the standard of filter construction is greatly to be desired. If the standards of performance are raised to the point where they belong, efficient filters will promptly appear. Then, and not until then, will the filter resume its rightful position as the most effective instrument yet devised for the complete purification of water.

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Michigan Sewage Works Association

On March 31 and April 1, 1932, the Eighth Annual Meeting of the Michigan Sewage Works Association was held at Michigan State College, East Lansing. This meeting was generally considered as the most successful of any yet held by the Michigan organization. There were approximately 75 registered for the meetings. An innovation this year was the short course in laboratory work given at Michigan State College on the two days preceding the Conference. This work was given under the direction of Professors Theroux and Eldridge. Twenty-three were enrolled for the course.

N. G. Damoose gave a description of the first year's operation of the Grand Rapids plant dwelling particularly on the results obtained and methods of operation.

W. A. Sperry, Superintendent of the sewage treatment works at Aurora, Ill., was present and presented a very interesting description of the operation of the Aurora plant. Of particular interest and significance was his description of controlling the plant operation to conform to the requirements of the stream receiving the plant affluent.

E. C. Schneider, a graduate student of Michigan State College, presented a paper showing the results obtained on a small trickling filter under different conditions of loading and the degree of purification obtained at various depths.

James R. Rumsey described the methods employed at Grand Rapids to promote public interest in their plant and insure popular interest and support. The talk was illustrated by slides, and inspired considerable discussion among those in attendance.

A talk on Bacteriology of Sewage Treatment by Professor Mallmann was very interesting and instructive.

A very informative discussion of the digestion of sewage solids was presented by A. J. Fischer of the Dorr Co. Many of the problems met in the operation of sludge digestion tanks were discussed and the best methods of overcoming difficulties suggested.

At a business meeting the following officers were elected for the ensuing year: President, John Jellema, Holland; Vice President, R. E. Kelley, Sturgis; Director, E. F. Eldridge, East Lansing; Secretary and Treasurer, W. F. Shephard, Michigan Department of Health, Lansing.

The new president appointed a committee on laboratory practice and a second committee on standardization of cost records. J. R. Rumsey of Grand Rapids and H. A. Olsen of Pontiac were appointed as members of the Board of Control of the Federation of Sewage Works Associates.

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P. S. Wilson Offers Unique Service

Mr. P. S. Wilson, formerly Superintendent of Operation of Community Water Service Company is now engaged in consulting sanitary and hydraulic engineering under his own name. Mr. Wilson is specializing particularly as an advisory consultant in *General Management of Public Water Supply Systems,* including not only the strictly engineering features such as purification and pumping, but also the other phases of the business such as the care of customers meters, commercial work, office organization, plant records, and similar matters.

Mr. Wilson's experience has particularly qualified him for work of this nature since his work with the Community organization placed him in intimate contact with all of the operating details of each one of the forty or more operating water companies of the system. Many of the methods used by the companies were developed by him.* Prior to this work Mr. Wilson was engaged under the late Mr. James H. Fuertes in engineering work consisting of the designing and construction of water works systems. Among the works upon which he was engaged were the enlargement of the filter plant, pumping station, and reservoir facilities at Harrisburg, Penna. and the design and construction of the 64 m.g.d. Marston Lake Filter Plant for Denver, Colo.

The service offered by Mr. Wilson is unique and should prove quite valuable.

*See article, this issue—"Meter Maintenance" by E. T. Cranch which describes procedures and methods devised under Mr. Wilson's supervision.

RECENT DEVELOPMENTS IN THE WATER WORKS AND SEWERAGE FIELDS

The Dorrco Aerator

The Dorrco aerator, the latest addition to the Dorr Company's line of sanitary engineering equipment, has been announced and is being introduced for general aeration work at sewage treatment plants of the activated sludge type. This new aerator is of the combined mechanical and diffused air type, and is distinctive in that the rotary motion of the sewage, induced by the mechanism, operates in a direction counter-current to that of the upward flow set up by the rising bubbles of diffused air.

The Dorrco aerator is supplied in the simplex, duplex and multiplex types, this designation corresponding to the number of series of motor-driven paddles used for the agitation and circulation of the sewage. In the simplex type, where only one series of paddles is used, the diffused air is admitted through a single row of porous plates set upon a narrow ledge projecting from one side of the tank a few feet above the bottom. In the duplex and multiplex types, the porous plates are placed upon one or more elevated ridges along the tank bottom and between the paddle shafts so that each row of plates serves the two series of paddles adjacent to it. By driving the paddles downward against—not upward with—the stream of rising air bubbles, the period of contact between air and sewage is increased, the air is distributed across the complete width of the tank and the amount of air required to secure a definite biological result is materially decreased.

The mechanism of the Dorrco aerator consists of a multiplicity of paddle wheel units, attached at regular intervals to a single shaft which passes axially through the tank. Each unit is made up of two diametrically opposite flat paddles, attached to the ends of three steel radial cross members which in turn are secured to and rotate with the shaft. Adjacent paddle units are oriented 22½° out of phase with each other for better mixing and better dynamical balance. Between these units are placed the bearings for supporting the main shaft, either from the sides or from the bottom of the tank.

The entire mechanism is below the water level and the tips of the paddle blades clear the sides and bottom of the tank and the water surface by half a foot or so. Imbedded in the tank side or bottom are the porous tiles for admitting the diffused air. These tiles are readily removable for inspection and cleaning and are provided with valves and extension stems for regulating the volume of air admitted to each section. The drive is very simple and consists of chain and sprocket connection to a motor and speed reducer located at the top of the tank.

The Dorrco areator is adaptable for installation in either new tanks or existing ones. It may be supplied in a wide range of diameters corresponding with various tank sections and due to the sectional type of construction may be built up to any reasonable length, with or without multiple drive units. The approved

The Dorrco Aerator for Sewage Treatment by the Activated Sludge Process Air Diffusors Along left Wall of Tank

and most economical duplex type of aerator consists of two series of paddles installed side by side in a concrete tank 24 ft. wide, 14 ft. deep and 100 ft. long, with a single central row of air diffusion plates on an elevated ridge along the long axis of the tank and with the paddles rotating in opposite directions so that the blades of both mechanisms move downward against the stream of rising bubbles at the center. This size of aerator has a rated capacity of one million gallons at six hours period of contact.

Dorrco aerators are installed at Escanaba and Muskegon Heights, Mich., and at Phoenix, Ariz. Tests at two of these plants have yielded certain comparative operating data on this aerator and aerators of the conventional straight, diffused air type. Whereas the diffused air type generally requires 0.8 to 1.5 cu. ft. free air per gallon of sewage and 20-35 horsepower input per million gallons, the Dorrco aerator secures the same biological result, measured by oxygen demand reduction, with 0.3 cu. ft. of air per gal. and a total power input (including both air compression and mechanism rotation) of 15-18 horsepower. The power consumed is divided almost equally between compressing the air and revolving the paddles and the economies realized are attributed to the unique and more efficient method of introducing the diffused air counter-current to the swirl imparted by the paddles.

An unusual feature of the Dorrco aerator is the feasibility of operating it on average domestic sewage without any compressed air whatsoever during the nightly period of minimum load. The rotating paddles prevent the segregation of solids, which otherwise would take place, and furthermore, the sewage received at the plant between 11 P. M. and 7 A. M. is generally so dilute and so reduced in volume that it is easily and safely absorbed by the old and fully aerated sludge in process of recirculation. No appreciable change in the quality of the final effluent is caused by this practice and obviously the shutting down completely of the air compressor plant for eight hours a day makes it possible to realize operating economies of an even higher order than mentioned in the foregoing.

Literature may be secured upon request to The Dorr Co., 247 Park Ave., New York City, or N. Michigan Ave., Chicago, Ill.

The Bacharach Multiple Feed Machine

One of the newer types of dry chemical feed machines manufactured by E. W. Bacharach & Co. of Kansas City, Mo., is shown in the illustration. It has heretofore been necessary to install a separate dry chemical feeder for each chemical used in a water purification plant. The multiple feed machine involves entirely new principles of operation. This device will accurately feed any number of dry chemicals simultaneously in the same, or

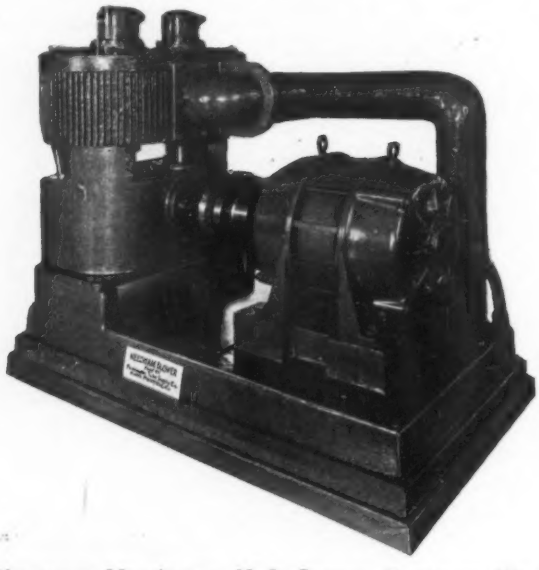
Multiple Chemical Feed Machine Developed by Bacharach

in different amounts. The machine may also be used to feed several different amounts of the same chemical to separate points of application. The illustration shows a machine built for feeding two chemicals, as, for example, lime and alum. The same principles of construction are utilized in building a machine for feeding three, or more, chemicals simultaneously. Some of the advantages of installing a single unit machine that will do the work of a number of individual devices are, reduced initial cost of apparatus, decreased in-

stallation expense, saving of space and power, less repairs and depreciation. The multiple machine is built for any capacity of feed and to meet the requirements of any particular installation. E. W. Bacharach & Company also build single feed machines and a complete line of chemical solution feed equipment. The Multiple Feeder is patented.

Needham Blowers Developed For Activated Sludge Plants

The Pneumatic Tube Supply Co., of Plainfield, N. J., have installed positive pressure blowers in the new Morristown, N. J., sewage treatment works of the activated sludge type designed by Clyde Potts and Weston Gavett, Engineers, New York City.



Blowers at Morristown, N. J., Sewage Treatment Works

This blower operates on the well-known and long-established principle of trapping the air between the impellers of enclosed rotating units. The Needham blower uses vertical impellers because the horizontal type gave trouble from oil or grease in the bearings and gears working into the compression chamber, thus mixing with the air and being forced out into the line.

By placing the impeller shafts vertically, the bearings and gears can be run in a bath of oil. This allows the use of ball or roller bearings, which greatly reduces friction, lengthens the bearing life and preserves the alignment of the impellers. The vertical shaft permits worm drive to both shafts at the same distance from the air load. This eliminates the slight twist of the shafts and consequent knocking of the impellers sometimes found in the horizontal type blowers.

The worm drive gives the necessary speed reduction, thus eliminating belts, chains and gears. With this particular design, the top cover can be easily removed for the inspection of the impellers, and, if necessary, the impellers themselves may be removed without tearing down the blower.

The vertical type with worm drive makes possible a shorter blowing unit, thus saving floor space.

Needham blowers are described in Catalog No. B-1 which is available upon request to Pneumatic Tube Supply Co., Plainfield, N. J., who have manufactured blowers for twenty years.

Aqua Nuchar Powdered Activated Carbon

Activated Carbon is a product of a certain special treatment which gives it the power to reach out and attach to itself certain other bodies, particularly colors, tastes, and odors.

It may help in an understanding of the behavior of Activated Carbon to consider an analogous phenomena, magnetism. If a piece of unmagnetized pure iron is passed over a mixture of iron filings and other ingredients, nothing happens. If, however, the iron is magnetized and then passed over the mixture, the iron filings are attracted to the iron and removed from the mixture.

Similarly, if ordinary carbon, no matter how pure, is mixed with a solution containing color, taste, and odor, and then filtered, no change is noticed in the liquid. But, by giving the carbon a certain special treatment, commonly known as activation, and then adding it to the solution, it will be found to have attracted the taste, odor, and color, and removed them from the solution.

Sample Can of Nuchar

It is probably unnecessary to point out that the behavior of Activated Carbon is not magnetic. The analogy is used to simplify the understanding of a rather unfamiliar phenomena in terms of one more generally known.

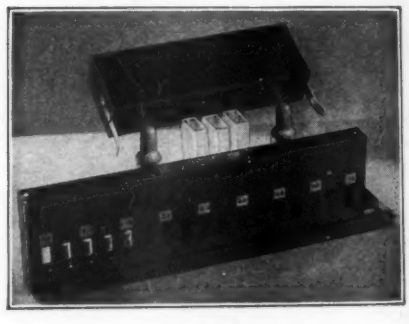
It is important to note that Activated Carbon has a power not ordinarily found in carbon. This power cannot be determined by chemical analysis of the carbon but only by the work it will do.

There are certain tests used in various laboratories to determine this power or degree of activation but the best way is to add some to the solution to be purified and observe the results.

W. A. Taylor & Co.'s Chlorimeter and Pool Test Set

The Enslow slide chlorimeter was designed for determining free or residual chlorine content of water, sewage, industrial wastes, condenser water, swimming pool water, etc.

The set consists of two principal parts, the slide and the base, both of which are molded from Bakelite. The slide is a Bakelite case 10 in. long, 2¾ in. high and



Enslow Slide Chlorimeter

⅝ in. thick. It contains 17 vertical holes and 17 horizontal slots which pass through the exact centers of the holes. In these holes are placed 9 standards representing 0.0, 0.1, 0.15, 0.2, 0.3, 0.4, 0.6, 0.8, 1.0 p.p.m. of chlorine and 8 ampoules of distilled water, the ampoules of water alternating with the color standards.

The base consists of two parts. The lower part contains a slot in which the slide moves back and forth, two holes containing vials of ortho-tolidin solution with 0.5cc pipettes and nipples, and three holes containing molded Pyrex cells. Horizontal slots run through these three holes in the base, the slots corresponding exactly with any three of the slots in the slide. The upper part of the base serves as a cover for the vials and cells when the set is not in use.

Determinations are made by three simple operations: (1) filling the three cells to the mark (11.5cc) with the sample to

be tested and placing them in the three holes in the base; (2) adding 0.5cc of ortho-tolidin to the central cell and mixing thoroughly; (3) moving the color standard slide back and forth in front of the test samples until a color match is obtained. The chlorine content in parts per million is then read off directly from the values on the front of the slide.

Color standard slides are also supplied for making pH determinations. A combination of an Enslow slide chlorimeter and a color standard slide for phenol red (pH 6.8-8.4) enables one to control *both the pH and chlorine content* of swimming pool water with a single instrument. Special combination sets of a chlorimeter and pH color standard slides covering the range 5.2-8.4 are supplied for water purification work.

Mathieson Alkali Introduces "H. T. H. 15"

"H. T. H." was introduced to the sanitary and allied fields about two years ago. It contains calcium hypochlorite in high concentration—sufficient to provide twice the available chlorine that is contained in ordinary chlorinated lime.

Because of the popularity of the original "H. T. H." there arose a demand for an equally stable product which would produce upon dissolving in water a solution of sodium hypochlorite rather than calcium hypochlorite.

Mathieson has perfected such a product within the year, and this is marketed under the trade name *"H. T. H.—15."* It is a preparation of H. T. H. in combination with a dry soda base and contains 15 per cent available chlorine. It comes packed in 3 lb. cans, one dozen to the case. Each can when mixed in 5 gallons of water produces a sodium hypochlorite stock solution containing 1 per cent (10,000 parts per million) of available chlorine. *"H. T. H.—15"* is therefore a companion product of the original H. T. H. which is packed in 4 lb. cans one dozen to the case or in 110 lb. metal containers shipped in carload or less than car lots in the water works and sewerage field.

H. T. H. has found a ready and economical application for algae control in water works, for slime elimination in steam condensers, around ice manufacturing and refrigeration plants, paper mills, sewage treatment works, ice box drains; for cleaning sand beds in filters, for swimming pool sterilization, for control of fungoid growths in shower rooms which causes athlete's foot and by numerous food industries such as dairies, etc. In addition H. T. H. is used in sewage sterilization and deodorization at small treatment plants—particularly in connection with treatment of water supply, swimming pools and sewage at summer resorts and institutional plants.

It is used for emergency chlorine application in a variety of situations and can be applied also through a spray gun.

"H. T. H.—15" might be termed also a household as well as a commercial product. Hypochlorite solutions are becoming more widely used than ever before and "H. T. H.—15" is an economical source for the preparation of household strength solutions—1 to 3 per cent available chlorine. "Zonite" contains 1 per cent chlorine for example and "Chlorox" 5 per cent chlorine.

For additional information address Mathieson Alkali Works, 250 Park Avenue, New York City.

Can of "H. T. H.—15"

Two New Water Meter Yokes by Mueller Company

The new water meter yokes developed recently by the Mueller Company of Decatur, Ill., are their G-10660 and G-10665 yokes.

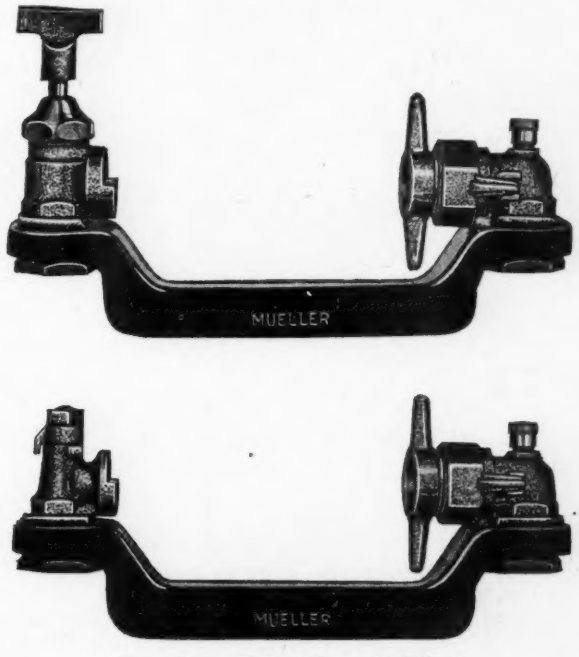
Some of the advantages of these improved yokes is found in the fact that the expansion connection in the new yokes is of a novel construction which has one less joint than any other expansion connection, and also has the advantage that it may be left on the yoke while changing a meter. However, it may easily be removed when a meter is removed, and this prevents water being used without the knowledge of the water company. These two yokes are the shortest on the market. The pipe threads in the inlet and outlet ends contain recesses which protect the threads from becoming weakened and from corrosion.

For the G-10665 yoke there has been designed a special inverted type of ground key stop which is the most satisfactory type of construction for a stop. A standard water works pentagon is on the head of this stop and, therefore, the same wrench which is used to open the meter box may be used to operate the stop.

The G-10660 yoke has a special compression stop containing a full seat opening with a stem which rises sufficiently high to give full water way capacity. All parts of these yokes which come in contact with the water are made of bronze. These yokes do not require the springing of the risers at any time.

All outlet ells are equipped with a test valve, making it possible to test the meters.

Literature sent upon request to the Mueller Company, Decatur, Ill.



Two New Water Meter Yokes of Mueller Co.

General Pipe Cleaning Company of Philadelphia Reports Achievements

The accompanying illustration (Fig. 1) shows the interior of 10-in. pipe before cleaning. The line was over two miles long and operated as a pumping main, the water being pumped from river to elevated tank.

Fig. 1

After cleaning the line, 46 per cent more water was delivered at tank and the pressure was doubled at tank with same pressure at pumping station.

Fig. 2

Entering 12-in. cleaner for a one-mile run (Fig. 2). This was a gravity system over three miles long and consisted of 10-in. and 12-in. pipe. Before cleaning the water flowing into reservoir was

Fig. 3

640,000 G.P.D. and after cleaning 1,300,000 G.P.D.

Figure 3 shows dirty water containing mud, silt, tubercles, etc., flowing out of cut in pipe line provided for removal of cleaning machine. This was a 12-in. main over 6 miles long. Williams & Hazen coefficient before cleaning was 86, and after cleaning 125, increase in flow being 40 per cent.

"John Crane" Plastic Semi-Metallic Packing

A new plastic packing, compounded according to a new formula, is announced by the Crane Packing Company, 1800 Cuyler Avenue, Chicago.

This packing consists of finely divided particles of anti-frictional metal, long fiber asbestos, pure graphite, a special lubricant and a perfected element of recent discovery which imparts entirely new performance characteristics, improving decidedly the service and efficiency heretofore obtained from plastic style packings.

Important features are the permanency of the lubricant in the packing throughout all conditions of services, low friction, non-scoring and non-freezing to shaft, plunger or rod. Homogeneous in the stuffing box without amalgamating. Retains resiliency and does not harden in service or when carried indefinitely in stock. Maintains a fluid tight seal with

"John Crane" Packing

minimum compression, making frequent adjustments unnecessary.

Pumps packed with "John Crane" Plastic do not have to be repacked as it is only necessary to add new packing to compensate for wear. It is manufactured in four styles to cover all services. Style 175 is recommended for general service on rotary and reciprocating equipment handling water, steam, air and ammonia.

It is manufactured in coil form and in bulk. The coil form is supplied in four sizes which are adapted to all stuffing box dimensions. It is easy to install without waste by cutting rings of proper size from the coil. This new "John Crane" Plastic packing is identified by a yellow interbraided thread.

Three Recent Developments By Link-Belt

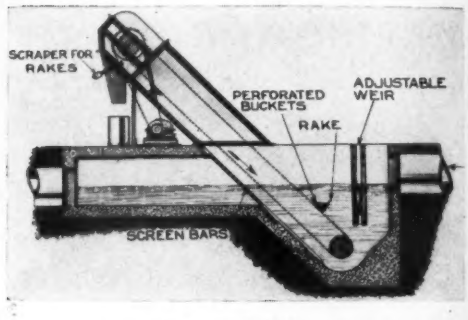
Link-Belt Aerator Mixer (Patents Pending)

This mixer is of the Link-Belt elevated diffuser type, using air for agitation. Rectangular tanks with a maximum of 16 ft., a maximum depth of 12 ft. and a detention period of approximately ¼ hour, are required. Elevated diffusers are located at one side of the tank. Approximately 50 cu. ft. of free air per minute per million gallons is required. About .05 K. W. is the power consumption. The velocity is regulated by valves regulating the flow of air to the different tubes. There is practically no loss of head and there are no dead spaces in the mixing chambers. Alum and lime may be introduced at different parts of the mixer.

Mixing Chamber with Link-Belt Elevated Diffusers at Water Purification Plant, Brownsville, Tex. Capacity 4 M. G. D.

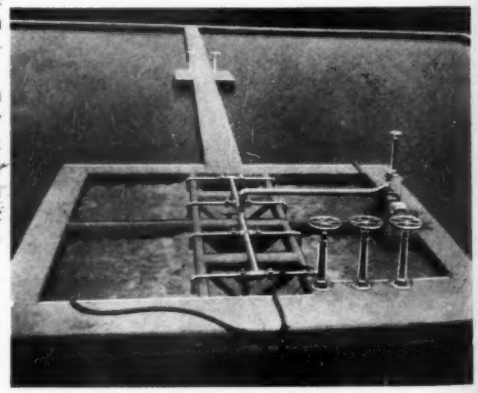
Type "C" Straightline Screens (Patents Pending)

This machine is a combined bar screen and grit chamber especially adapted for use at medium and small size plants. A



Type "C" Straightline Screen

hopper in front of the screen collects the sand and other heavy material. A baffle in this hopper regulates the velocity through it and prevents the accumula-



Link-Belt Mieder Collector for Primary Settling Tanks

tion of organic matter that is taken care of in the settling tank. Perforated buckets remove the material collected in the hopper and rakes clean the bar screen. The scraper removes the material collected on the rakes that doesn't drop off when the rake goes over the

head sprocket. The rakes of this machine clean the bar screen from top to bottom and therefore jamming of the rakes at the bottom of the screen is impossible.

THE MIEDER COLLECTOR

This collector has been developed for the removal of sludge from primary settling tank. It is a deep scraper suspended from a traveling bridge that moves the sludge settled out at the bottom of the tank towards the influent end. On the return run the scraper is raised to the surface and used for skimming the top of the tank. The machine can be transferred from one tank to another. At Leipzig, Germany, one machine serves four tanks approximately 40 ft. wide and from 160 ft. to 200 ft. long.

All of the driving machinery is located on the bridge and out of the sewage, and the scraper may be inspected at any time it is raised from the sewage.

Descriptive literature may be had upon request to the Link-Belt Co., Philadelphia, Pa.

Rawhide Packing for Use in Sewage Plants

Our attention has been called to the probable benefits which will result from the use of Mabbs rawhide packing at sewage plants, for the reason that it is claimed to prevent serious wear and cutting of the metal surfaces such as valve stems and centrifugal pump shafts. It is contended that rawhide packing, when saturated, is too soft to hold the particles of grit upon its surface and they work back into the body of the packing, thus protecting the metal surfaces from wear and cutting.

Mabbs Rawhide Packing

The United States Government has been using this packing for some time and it is said that rawhide packing is so nearly anti-frictional that it will save considerable in power in addition to its other advantages. Such has been the experience of users at water works.

For literature write Mabbs Hydraulic Packing Co., 431 S. Dearborn St., Chicago, Ill.

National Makes New Mechanical Joint

The National Cast Iron Pipe Co., Birmingham, Ala., and the James B. Clow Company, Chicago, have developed during the past year a new mechanical joint for cast iron pipe, the principal feature of which is a cast iron apron that covers the tension section of the bolts to protect them against corrosion. Old joints of similar design have been uncovered after 40 years service, showing that the cast iron covering does protect the bolt. In the new joint, called Flexklamp,

Flexklamp Joint

the bolts are made of alloy malleable iron and it is claimed these bolts in this joint will last as long as the pipe.

The Flexklamp gland automatically centers itself in the joint. It is used with standard bell and spigot pipe, with the inside of the bell slightly changed to form a seat for the gasket which is made of compounded rubber. The joint is used both for water and for gas mains.

Descriptive literature is available upon request.

An Iron Removal Zeolite "Ferrosand"

The Inversand Company of Clayton, N. J., are offering their iron removal zeolite, Ferrosand, for the complete removal of dissolved iron and manganese from water.

Ferrosand, although improperly regarded as a zeolite, has the property of oxidizing dissolved iron to the ferric condition. When thus oxidized the iron is retained entirely upon the surface of the grains of Ferrosand in the form of a soft paste.

Physically, Ferrosand is a granular sand-like substance having an effective size of 0.33 m.m. and a uniformity coefficient of 1.5. It weighs 93 lb. per cubic foot. It is nearly black in color and corresponds in hardness to the hardest of the zeolites. Chemically it is a double silicate of iron and manganese.

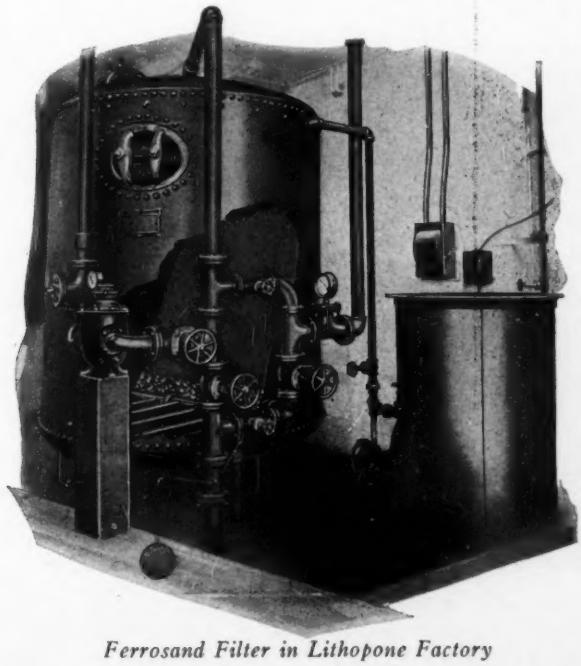
Ferrosand is employed as a filter medium for the removal of dissolved iron. It is placed in an ordinary water filter which is operated at a rate of about three gallons per square foot per minute. It is regenerated with potassium permanganate employing two ounces of potassium permanganate per cubic foot of Ferrosand. When thus regenerated each cubic foot has the property of removing 250 grains of iron and manganese from water.

When the filter has become exhausted and traces of iron manifest themselves in the filtered water, it is then washed to remove the iron which has been precipitated entirely upon the surface of the grains, and is then regenerated. The excess of potassium permanganate is washed out, after which the filter is in condition to be again operated.

A wash rate of nine gallons per square foot per minute will effectively remove all of the oxidized iron.

Ferrosand is especially applicable to those conditions where complete elimination of the iron from water is essential. In its ordinary performance the iron is reduced to a range between 0.00 p.p.m. to 0.03 p.p.m.

By reason of the fact that Ferrosand is practically a non-porous substance and that the oxidization of the iron takes place entirely upon the surface without any penetration whatever, it is believed that Ferrosand will not be subject to more than slight deterioration through years of



Ferrosand Filter in Lithopone Factory

use and that in a properly designed filter it will not gradually become coated with iron. This belief is substantiated by two years practical operation.

The use of Ferrosand is indicated in the treatment of well waters having an iron content of two parts or less per million gallons, as a finishing treatment for those waters which only partially respond to aeration and filtration. Those waters which respond sluggishly to chemical treatment and reduce the iron to a colloid rather than a solid form that can be readily retained by sand filters are particularly amenable to Ferrosand treatment.

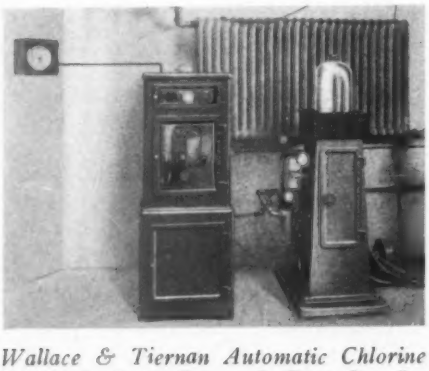
By reason of the fact that no interval is required between the pumping of the water from a well and its filtration, Ferrosand can often be used to advantage in pressure units to avoid storage basins and secondary pumping.

New W. & T. Equipment

Hellige Chlorine Comparator

The ortho-tolidin test, generally accepted as the most accurate means of measuring residual chlorine, forms the basis for this new and improved chlorine comparator. Use of non-fading, accurately calibrated glass color standards does away with the preparation and renewal of liquid color standards.

Wallace & Tiernan Chlorine Comparator, Hellige Type



Wallace & Tiernan Automatic Chlorine Residual Controller and Recorder Installed at Rahway, N. J.

Wallace & Tiernan Type "O" Dry Feeder equipped for use with the Automatic pH Recorder and Controller (not shown)

Wallace & Tiernan Type "O" Dry Feeder Equipped for Use with the Automatic pH Recorder and Controller

Color plates in a circular disc revolved in front of the sample give direct readings of residual chlorine in parts per million. Two tubes are used, one for the sample containing ortho-tolidin, and one for a blank, thus insuring accurate determinations of colored or turbid samples. The unit is enclosed in a durable, corrosion-resistant Bakelite case and is small enough to carry easily in coat pocket or bag.

So easily are accurate determinations made with this new comparator that inexperienced operators can use it after only a few minutes study.

W & T Remote Indicating and Recording Instruments

W & T indicators and recorders indicate and record variations in liquid levels, vertical movements of gas holders, positions of valves and sluice gates or any straight line or angular motion, at any distance from the point of measurement.

Knowledge of water storage conditions is essential to the successful operation of hydroelectric systems and water supplies. Permanent records of day by day changes correlated with plant operating data make accurate future planning possible and eliminate unforeseen shortages. W & T remote indicating and recording instruments measure these water levels and transmit the information directly to some central point such as the pumping station or water superintendent's office.

W & T Automatic pH Recorder and Controller

Another recent development of Wallace & Tiernan research staff has been the Automatic pH recorder and control unit. Designed to give flexible and accurate control of dry feed application, it marks a real contribution to the field of water works equipment.

The pH value of the water is continuously indicated and recorded, a combination of contacts in the recorder in conjunction with an anticipatory control unit regulating the feed of lime or other chemical. The anticipatory mechanism analyzes the shape, speed and direction of the pH curve as drawn by the recorder and makes adjustments in the chemical application of the proper frequency and magnitude to correct deviations from the optimum pH as quickly as possible.

The mechanism is so designed and built that when rapid changes occur in the water—due to variations in flows, etc.—the chemical feed is varied in proportionate rapidity. Likewise, when the pH changes only slightly the adjustments are less frequent or smaller.

The Filclorator

One of the most interesting devices introduced into the chlorination field during the past year, is the Filclorator, made by the Filclor Company of Philadelphia, Pa.

The Filclorator has been introduced to meet a pressing need in the operation and maintenance of chlorine apparatus, and is particularly applicable to the water works, sewage, and kindred fields where continuous uninterrupted performance is as essential as is chlorination itself. The prime purpose of this ingenious device is to extract impurities from chlorine gas, which by virtue of existing conditions become troublesome when allowed to find their way to the chlorinator. They clog and gum up the small ports and orifices of the delicate control mechanism, and thereby cause a stoppage which results in subsequent shut down, necessitating respairs and undue expense. By eliminating the cause of stoppages the potential dangers of failure of chlorinators to function, during the absence of an attendant, are reduced to a minimum.

The Filclorator

The Filclorator is attached to the outlet of the chlorine container. The gas passes consecutively through an orifice gauged to meet the required rate of flow, to a pre-expansion chamber thence to a scrubber and finally through a filter. By this arrangement all impurities that might otherwise deposit in the chlorinator are retained in the Filclorators.

In order that the Filclorator might conform to every requirement of simplicity, it is of unit design. In this form it is easily installed, requires no attention and should be a most valuable part of every plant, particularly those located some distance from experienced help.

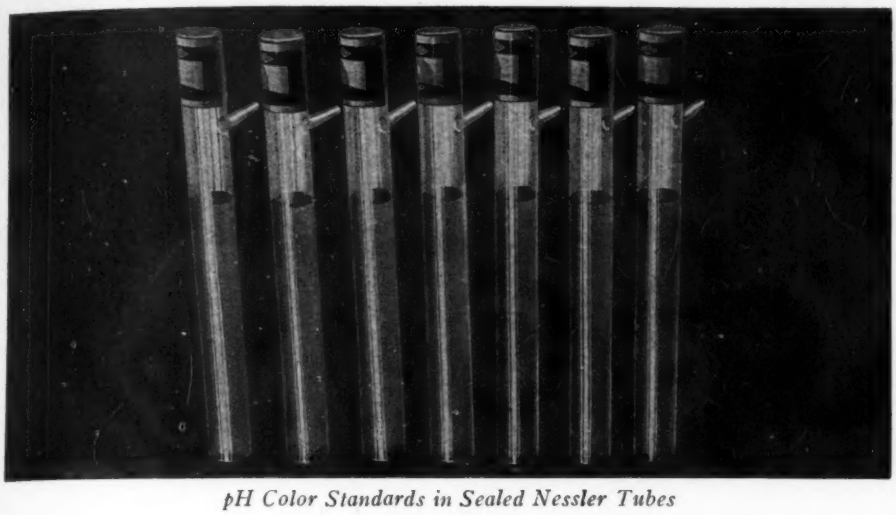
As an economic adjunct, the Filclorator pays for itself often within a short time after installation.

Filclorators are made in a variety of sizes to meet the demand of any size or type of plant.

Request literature from The Filclor Company, Commercial Trust Bldg., Philadelphia, Pa.

pH Standards in Sealed Nessler Tubes

The careful adjustment of indicator solutions is receiving more attention on the part of water works chemists and has resulted in new efforts to secure extreme accuracy in pH determinations. Recent developments in the LaMotte Laboratories completely overcomes the unfortunate tendency towards the use of large amounts of indicator in a small amount of sample. In the LaMotte laboratories, pH color standards have been produced in sealed double and Nessler tubes in which allowance is made for the use of a minimum amount of indicator solution in making the test, thus overcoming any tendency for the indicator solution to affect the final result. This is especially interesting to those who are required to make pH determinations on unbuffered solutions.



pH Color Standards in Sealed Nessler Tubes

Literature supplied upon request to the LaMotte Chemical Product Co., McCormick Bldg., Baltimore, Md.

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The Ludlow Diamond Fire Hydrant Modern and Attractive

The improved "Diamond" fire hydrant manufactured by the Ludlow Valve Manufacturing Co. of Troy, N. Y., is a self-illuminating and architecturally attractive piece of water works equipment. It is rugged but at the same time its appearance is in strict keeping with the spirit of modern design.

Even though its visibility at night is excellent, should a careless driver crash into a "Diamond" Hydrant there can be no flooding of streets or water damage to property. Replacement of a broken body requires but a few minutes and a wrench to remove 8 "rust-proof" bolts at the base which is just above ground. It is not longer necessary to stock complete hydrants of various lengths. The hydrant body and the valve at the main are connected by a flanged connecting barrel of required length for any given location.

The design of the hydrant body is such that breakage from impact will always occur above the flange at ground level, therefore there will be *no digging required* in replacement.

Aside from features such as beauty, ruggedness and ease of replacement of the Ludlow "Diamond" Hydrant body "what is under the hood"—i. e., the Ludlow Valve proper has several distinct advantages.

The Ludlow slide gate valve in closing operates against the flow, is evenly seated by wedge action of the bronze nut, and therefore *causes no water hammer* on closing. When fully open the gate seat is little or none subjected to abrasive action during flow of water. *Without digging*, the entire mechanism of the valve can be removed and without disturbing the bronze seat ring. The drip hole is at the extreme bottom of the hydrant which provides for complete drainage, allowing no water to stand and freeze.

Ludlow Diamond Fire Hydrant

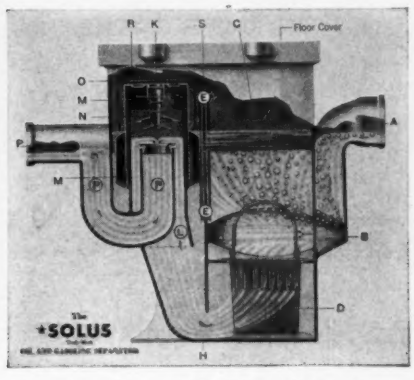
Practical and ornamental, is the improved Ludlow Diamond Fire Hydrant.

For better description request literature on List No. 90 from The Ludlow Valve Manufacturing Co. at Troy, N. Y.

The "Solus" Oil and Gasoline Separator Prevents Sewer Explosions

The above cross sectional view shows the construction of a new oil and gasoline separator claiming new and distinct safety features. It is known as the "Solus," is approved by the Underwriters, and is made by The Central Foundry Company of New York City.

(1) Guarding outlet pipe (P) is brass float (M) which is sensitive to, and actuated by, difference in specific gravity of water and oil. This brass float floats in water and sinks in oil and gasoline. When over-accumulation of oil and gasoline at top of two chambers is not removed, brass float (M) sinks and safety valve (float-valve) inside brass float simultaneously and automatically closes outlet pipe to the sewers.



"Solus" Oil and Gasoline Separator

It is easy and safe to clean. Instead of climbing down into a filthy, fume-laden pit, the workman simply lifts the floor cover and pumps out the accumulation of oil and gasoline. The cleaning process in no way interferes with the continuous operation of the separator.

For additional information request literature from The Central Foundry Co., Graybar Bldg., New York, N. Y.—makers of Universal Cast Iron Pipe and Fittings.

Cross Section Showing Construction of

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"Sani-Tite"— a Dependable Sewer Joint Compound

The Hydraulic Development Corporation, 50 Church St., New York, N. Y., who have manufactured Hydro-Tite, a self-caulking cast iron water pipe joint compound, for over twenty years have recently developed "Sani-Tite," a new bituminous joint compound for vitrified or concrete sewer pipe.

"Sani-Tite" is put up in 300 and 400 lb. drums. It is easy to melt and pour. Many points of superiority over ordinary sewer compounds are claimed for it.

Full information about "Sani-Tite" will gladly be furnished by the Hydraulic Development Corp., 50 Church St., New York City, upon request.

New Precision Feeder and Laboratory Stirrer

A new feeding and measuring device of the solution type which will handle an extremely wide variety of materials has been brought out by the Omega Machine Co., 4010 Penn Ave., Kansas City, Mo.

The feeder was developed primarily for feeding relatively small quantities from a few grains to 100 lb. or more per day, and for handling solutions of materials such as chlorinated lime "H T H," caustic soda, ammonium sulphate, "Perchloron," etc.

The feeder is designed on the principle of filling a tank with liquid or solution of known strength. To an outlet near the bottom of the tank a flexible hose, or pipe, is connected, located either inside or outside the tank, with the movable end of the hose level with the liquid in the tank. The movable end of the outlet hose is then lowered by suitable mechanical means at such a rate that a known amount of solution will be delivered from the tank in a given time interval.

By the use of suitable control mechanism the solution from the tank may be delivered at a uniform rate or at a rate proportional to some other function, such as the flow of water through a meter or over a weir. If an intermittent feed is desired the device can also be arranged to measure and deliver fixed quantities of solution at predetermined intervals.

The control mechanism is, in most cases, electrically operated by a synchronous motor, but clock mechanisms or other forms of control are available. The solution tanks may be of any required size, from 1 gal. upwards. Tanks and fittings are constructed of glass, earthenware, rubber, steel, acid-resistant metals, or other materials suitable for the particular service required.

The tank is generally designed to hold enough material for a 24 hour run. The maximum capacity is limited only by the capacity of the solution tank, which may be of any desired size.

The Omega Machine Co. also has brought out a new laboratory stirrer. This device is primarily for use in water purification and softening plants for stirring samples of water, treated with various amounts of coagulants or softening chemicals, to determine the dosage, degree of agitation and the mixing and settling periods required for the best results.

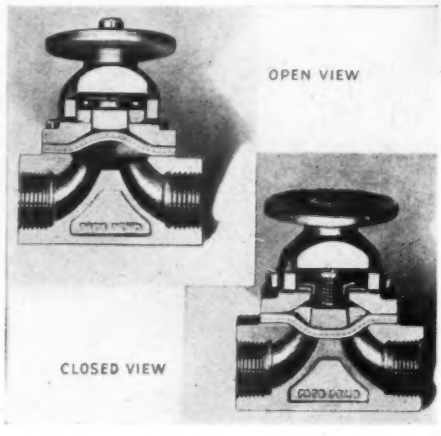
The device has a heavy steel frame, supporting the motor, which is directly connected by a drive shaft to each of the stirring units which are driven by individual worm gears running in oil. The vertical agitator shafts revolve at a speed of 60 r. p. m. It is not necessary to stop the machine in order to put in or remove a sample being tested.

The stirrer is made in four sizes, with three, four, five or six units as may be required. The three-unit size is 7 in. wide, 21 in. high and 27 in. long and will accommodate three jars of any size up to 1 gal., and any height up to 12 in. Each additional unit increases the length 7 in.

Valve Constructed on Entirely New Principle

The Hills-McCanna Company, 2349 Nelson St., Chicago, have acquired manufacturing and sales rights on a valve that was designed and perfected by P. K. Saunders, a mining engineer in South Africa. The valve was originally intended to eliminate leaks in water and air lines that caused a large unnecessary expense each year. Ordinary valves with metal to metal seats were not satisfactory due to scale and other foreign substances settling on the seats preventing a tight closure.

The valve he perfected has no metal to metal seats, no stem packing or stuffing boxes, and is recommended for general service. The materials handled never reach the valve bonnet. The diaphragm protects all the working parts from the substances handled. This is a big feature when handling volatile liquids, gases and air, liquids having gritty solids in suspension and corrosive liquids. Access to the bonnet or body does not require removal from the line. Corrosion resisting valves of any commercial material are priced in the range of iron valves due to the design that requires only the body to be cast in special metals.



Views of Valve in Open and Closed Positions

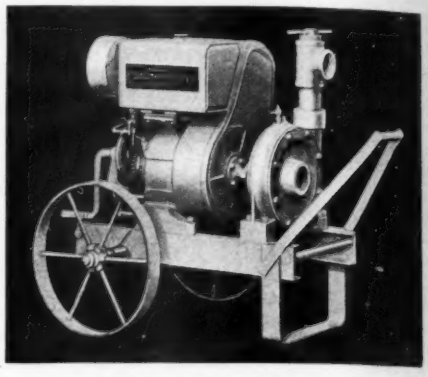
In the closed position the diaphragm is compressed between the compressor follower and the seat. An even distribution of pressure on the diaphragm is secured thru proper design and machining of the seat and compressor.

Literature is available.

Portable Diaphragm And Centrifugal Pumps

The "Mud Hen" is a diaphragm pump developed by the C. H. & E. Manufacturing Co. of Milwaukee, Wis. The diaphragm is changeable in four minutes time. It is mounted on a two wheel trailer. It has a 4 in. side suction and is driven by a 2 H.P. single cylinder Stover engine. At 10 ft. lift the capacity is 8,000 gallons per hour and one-half that at 20 ft. lift. Weight including trailer is but 700 lb.

The C. H. & E. Manufacturing Co. also offer a portable light weight centrifugal pump for pumping out manholes, sewers, etc. It has an open type impeller which will pass one inch objects. The 35 H.P. Harley Davidson engine is direct connected. The suction is 3 in. and pump has capacity of 18,000 gallons per hour operating under 20 ft. total head.



C. H. & E. "Mud Hen" Pump

Address C. H. & E. Manufacturing Co., 120 E. Mineral St., Milwaukee, for additional information if desired.

Liquid Chlorine Now Produced by Monsanto of St. Louis

Beginning January 1, 1932 the Monsanto Chemical Works at St. Louis, Mo., began offering liquid chlorine delivered in 150 lb. cylinders to consumers in the middle-west. Monsanto has manufactured liquid chlorine for its own consumption for several years but not until recently has the Monsanto product been made available in small cylinders to the trade at large. Monsanto is the only mid-western producer of chlorine.

Literature will be sent upon request to the Monsanto Chemical Works, at St. Louis, Mo.

POSITIONS WANTED

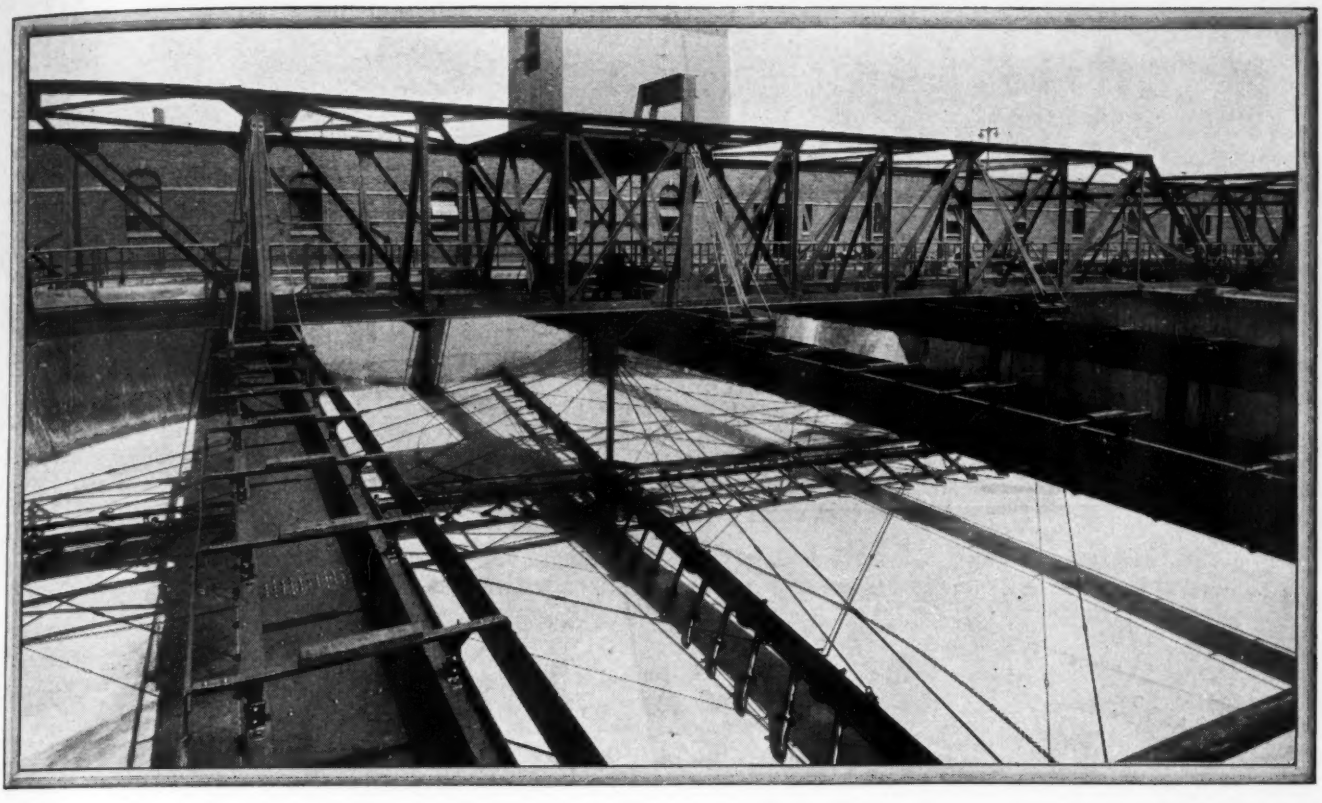
This department has been started as a service to those in the Water Works and and Sewerage Fields. We hope they will make use of it. The notices are inserted without charge.

WATER CHEMIST — B. A. in chemistry from well known university. Two and one-half years' chemical and bacteriological experience as first assistant in state health department laboratory. Have had practical experience in water plant operation and supervision. Available immediately. Excellent references. Single. Age 25. Box 5000, Water Works and Sewerage, 400 W. Madison St., Chicago, Ill.

ENGINEER-CHEMIST—Age 35; ten years with city of 36,000 population in charge of water, light and sewer systems, water filtration and two modern sewage treatment plants. Desires position as superintendent, assistant superintendent or plant superintendent. Box 5020, Water Works and Sewerage, 400 W. Madison St., Chicago, Ill.

MARRIED MAN, 36 years old, with 13 years' experience in water purification plant control and operation, also experienced in water meter repairing and testing. Best of references can be furnished. Box 5010, Water Works and Sewerage, 420 Lexington Ave., New York City.

CHAIN BELT COMPANY



Announces the Tow-Bro Clarifier

The Tow-Bro Clarifier is a new unit of Sanitation Equipment, built by the Chain Belt Company, primarily for sludge removal from secondary settling tanks in activated sludge plants. It is also recommended for final settling ("humus") tanks in trickling filter type plants.

Essentially, it removes the sludge directly without moving or ploughing it about the tank.

The Tow-Bro Type mechanism consists of radial headers, each carrying a series of inlet nozzles which converge at and revolve around a central point.

The slowly revolving mechanism collects the sludge by hydrostatic pressure through the inlet nozzles, which just clear the bottom of the tank. They sweep the entire tank floor in a single revolution, removing the sludge with a minimum of disturbance, and virtually no movement of sludge within the tank. These nozzles collect the sludge which then flows through the revolving headers to the central outlet and sludge pipe line under the tank bottom.

The Tow-Bro Clarifier has these special advantages: A more concentrated sludge is obtained. Hence, there is less material to be pumped as returned sludge. More capacity is then available through the aeration and final settling tanks.

The sludge is in the tank a shorter time, so has less chance to become septic. Because the sludge is directly removed from the entire bottom, a better settling condition is obtained, together with a clearer effluent. There is less agitation of the sludge as the headers are about 30" above the tank bottom and the inlet nozzles remove the sludge as soon as they come in contact with it.

In its offer for general use, the Tow-Bro Clarifier is new and is exclusive with the Chain Belt Company. In practical application, four of these clarifiers are in regular continuous service at the Milwaukee Sewage Treatment plant —the first one has been in operation for 3½ years.

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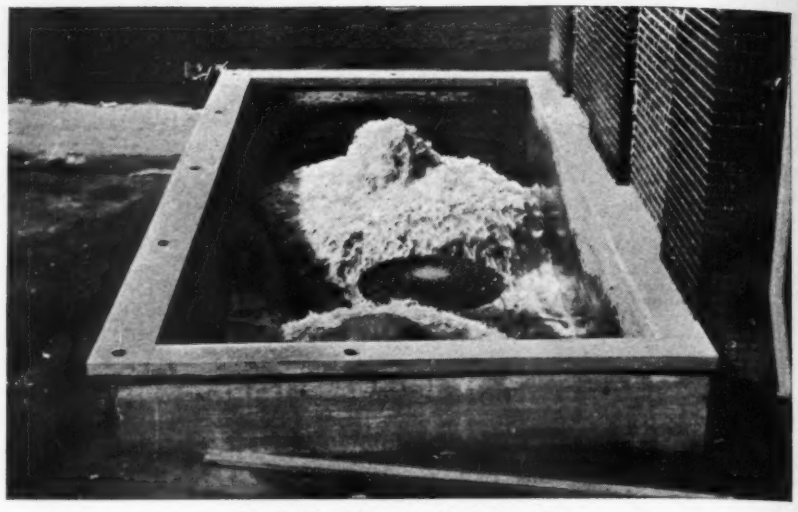

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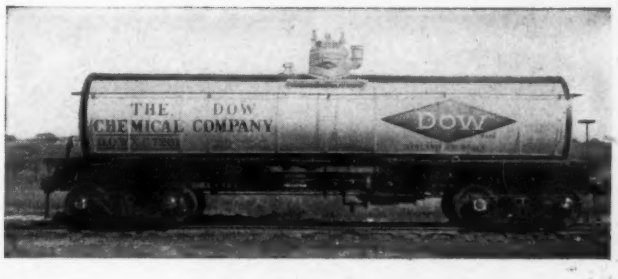

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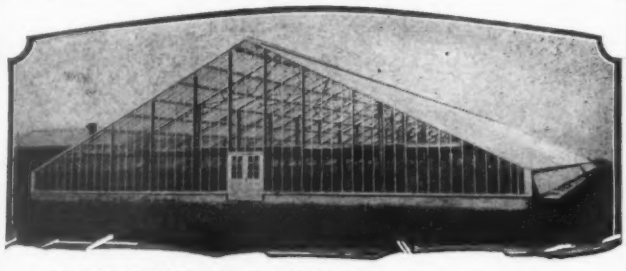

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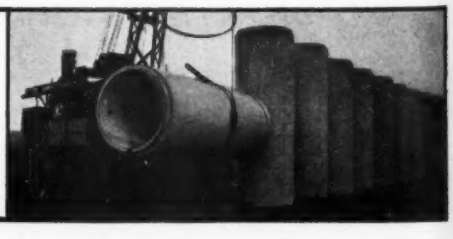

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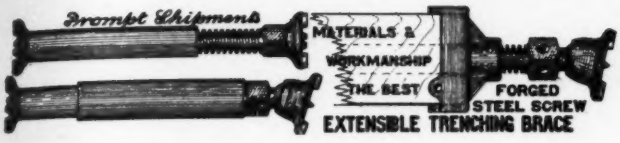

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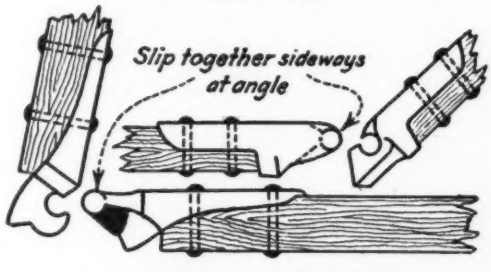

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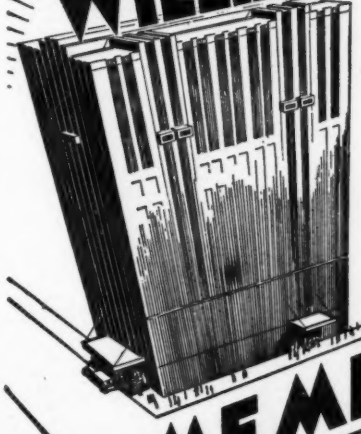

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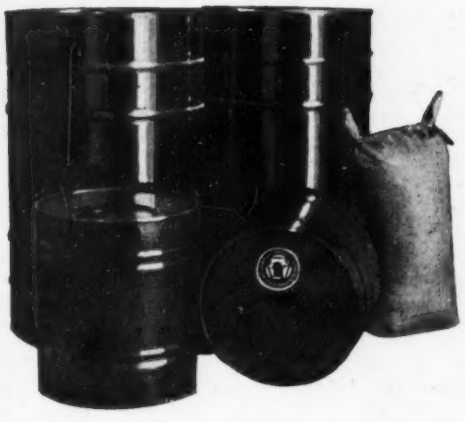

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ABC ABP

May, 1932 — Editor — Vol. LXXIX. No. 5

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Memphis Water Works: Sheahan Pumping Station (Center); Aerator Building (Right), and Filter Plant (Left). Engineers: Fuller & McClintock.

IN THIS ISSUE

Reports of the Memphis Convention of the American Water Works Association

High-Lights on European Sewage Practice

Design Features of Activated Sludge Plants

Lime-Chlorine Process at Baltimore, M. D.

Plates mailed to Swimming Pool World, N. Y. City 5/31/32

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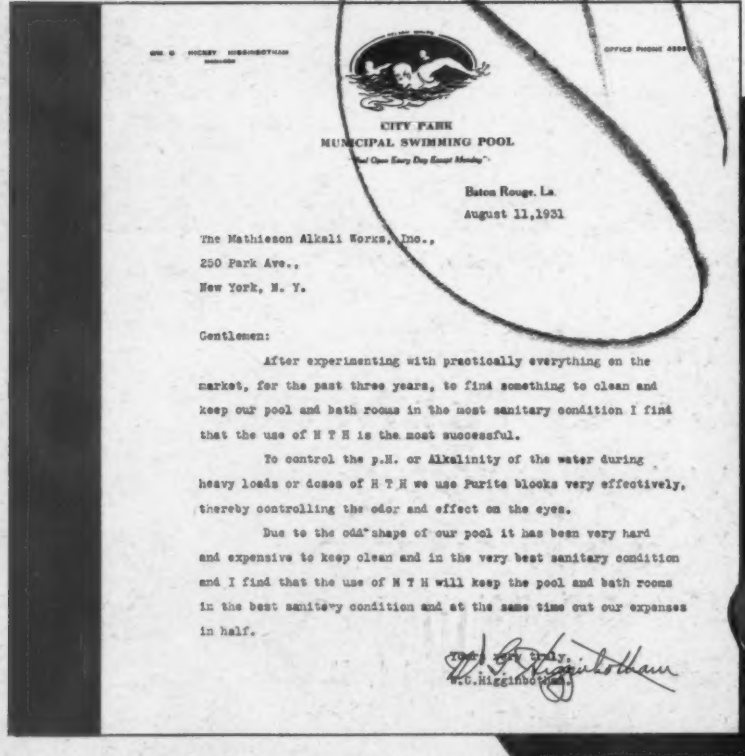

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